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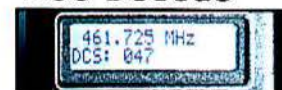
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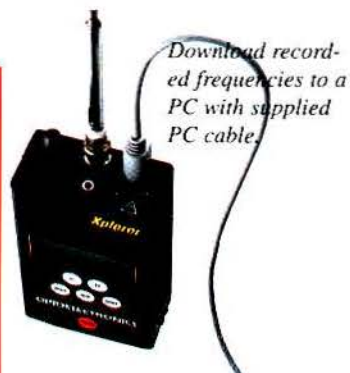
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## features

### 10 Gimme shelter: Alternatives for housing remote equipment

*Donald E. Koehler*  
'Alternative' equipment shelters can be steel, timber and concrete structures.

### 16 Advances in police tactical communications

*Michael J. Major*  
Headgear and encryption devices lead the way.

### 22 It's 2:30 a.m.; Do you know where your paging system is?

*Vaughn Entwistle*  
Even large paging operators cannot baby-sit a system 24 hours a day.

### 26 Microwave path design: The basics

*Jeff Ashley*  
*Part 1* — This four-part primer on propagation-related basics begins with "line-of-sight" determinations and the evaluation of path clearances with regard to refractive effects.

### 34 Radiating cable improves in-building wireless

*Klaus Haas and  
Gregor Veithen*  
Coupled with a DECT-standard system, radiating cables reduce the required number of base stations and extend coverage into interior spaces.

### 38 The lives and times of MRT

*Ernest Worthman*  
In honor of MRT's 15th anniversary, come take a stroll back through the history of the magazine and the industry it serves.

## departments

### 4 Editorial

### 6 Calendar

**8 Technically speaking**  
*Harold Kinley, C.E.T.*  
Electromagnetic compatibility vs. mobile radio installations.

**54 Regulating technology**  
*Robert H. Schwaninger Jr.*  
Toward gentility.

**57 News**  
Chadmoore looks at long-term financing.

**64 Product focus**  
Headsets.

**66 New products**  
Zetron is the "Readers' Choice."

**76 Literature**

**77 People**

**78 Letters from readers**

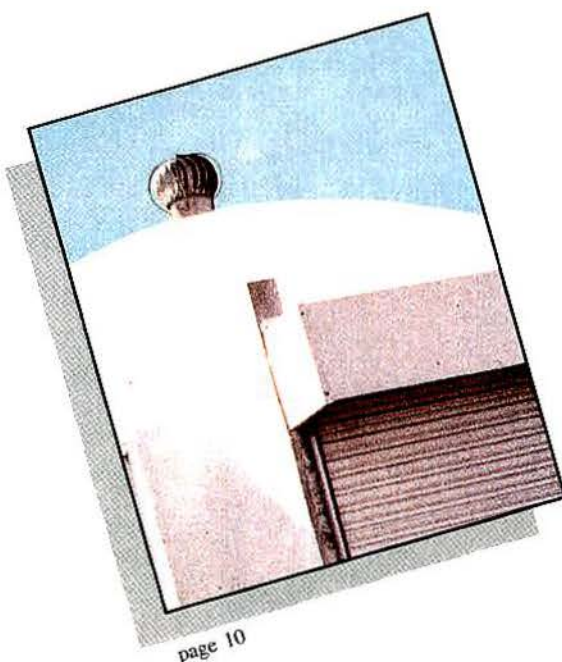
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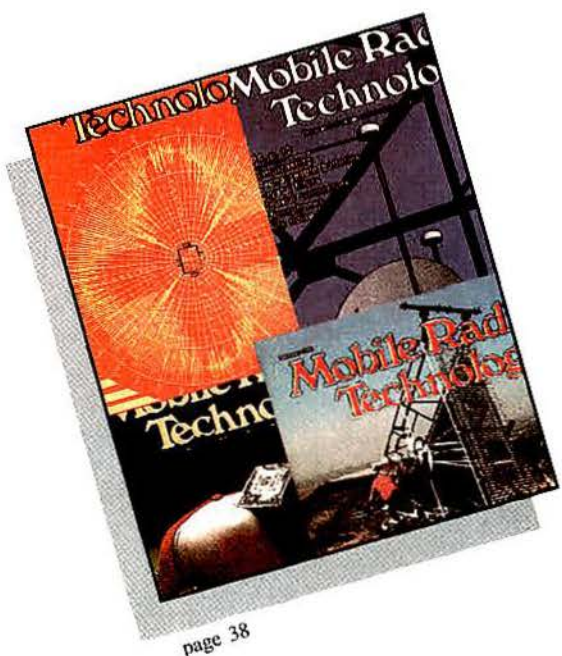
**On the cover:** The Ecoshell concrete shelter from Monolithic Dome houses remote equipment in a smaller structure that can be purchased complete and transported to the site. *Photo courtesy of Monolithic Dome, Italy, TX.*

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page 10



page 38



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Pat Wiesner



Jim Fahnestock - 1983



Phil Cook



Mercy Contreras



Nikki Chandler



Don Bishop



David Keckler



Scott Dolash



## Mobile Radio Technology: Celebrating 15 years

The first issue of *Mobile Radio Technology* bore the date January/February 1983. Three partners who owned Wiesner Publishing Company in Littleton, CO, launched the magazine: E. Patrick Wiesner, James D. Fahnestock and Phil D. Cook.

When they previously were executives with Cardiff Publishing, Wiesner and Cook started other magazines and managed *Communications*, perhaps the first magazine to cover the business and industrial land mobile radio industry. Fahnestock had previously edited electronics magazines and had published a daily city newspaper.

In the 1970s, looking for a better place to raise his family, Fahnestock decided to move from New York to Colorado. He met Wiesner when he applied for a job with Cardiff. No job resulted, but with common interests in golfing and flying, he and Wiesner became friends. Fahnestock went into business distributing computer hardware. He relocated to Evergreen, CO, establishing his company under the name of Westek.

Wiesner exited Cardiff in 1980 and hung out his shingle as a publishing consultant; meanwhile, he and Fahnestock talked about starting a publishing company. They convinced each other, formed Wiesner Publishing in 1982 and launched its first magazine, *Satellite TV*. The magazine continues today under a different owner and under the name *Private Cable*. A few months after the first magazine was launched, Cook became the third partner and began work in September 1982 to launch *Mobile Radio Technology*.

I became an employee and trained under Fahnestock beginning in April 1983, working initially on the two magazines and later, several others. Mercy Contreras, now a group publisher with *MRT's* current owner, left her job at Cardiff and became a Wiesner Publishing employee in July 1983, selling advertising in *MRT*. Cook sold his partnership interest about a year later and went on to launch magazines and other businesses of his own and to represent other publishers. In 1986, Intertec Publishing purchased *MRT* along with two other magazines from Wiesner Publishing. Not long afterward, Fahnestock sold his company stock.

Today, Wiesner publishes a number of magazines as majority owner of Wiesner Publishing, which now is headed by his son, Dan. Fahnestock is retired and pursues interests in travel, flying, amateur radio and computers. Cook joined Intertec in 1997 and sells advertising in *RF Design* magazine as the marketing manager for the western United States.

Talk about change. When I went to work at Wiesner Publishing, I was one of seven employees. Intertec is large enough that the employee count fluctuates daily, but the total is about 1,400. Quite a difference! In fact, it is impossible to identify all of the individuals who now contribute effort toward the magazine, because upwards of 50 to 100 employees spend time ranging from a tiny amount to full time on *MRT* in various roles.

I'll name a few, though. Raymond E. Maloney, in 1986, as vice president of finance for a much smaller Intertec, helped with the acquisition. He now is president and CEO of the company. Cameron Bishop, now senior group vice president, was a key player in the acquisition as a group vice president in 1986 and has been among our executive management ever since. Eric Jacobson, now vice president of business development, was our publisher during the first few years at Intertec.

Our current editorial team includes David A. Keckler, features editor; Nikki Chandler, associate editor; and Scott Dolash, associate art director. Our two most active advisers are Raymond C. Trott, P.E., who began helping us in 1987, and Robert H. Schwaninger Jr., who became our regulatory consultant and columnist in 1992. Schwaninger followed Alan Tilles, who had filled a similar role beginning in 1991. Harold Kinley, C.E.T., brought us the idea for and began writing the "Technically Speaking" column in 1993. A writer and west coast editor during the magazine's infancy was Jack Daniel. Last, but certainly not least, on this roster of staff members, advisers and other regular contributors, is Fred M. Link. Link, a pioneer two-way radio manufacturer, became our industry consultant in 1984 during the Wiesner days.

Julie Neely is our circulation manager; Dennis Hegg and Joyce Bollegar sell display advertising. (Hegg started with Intertec in 1982 and was assigned to *MRT* when it was acquired.) Dawn Rhoden sells classified advertising. Scott Hanna and Patti Lee coordinate the advertising materials.

Wiesner, Fahnestock and Cook conceived the idea for the magazine and launched it; many fine people have given it their energy and skills in the intervening years, and it has a superior team of contributors, staff and managers today. Mercy and I join in thanking everyone who has had a role in giving their talents to the magazine during its first 15 years, as well as the readers who have welcomed it and the advertisers who have supported it.

—Don Bishop



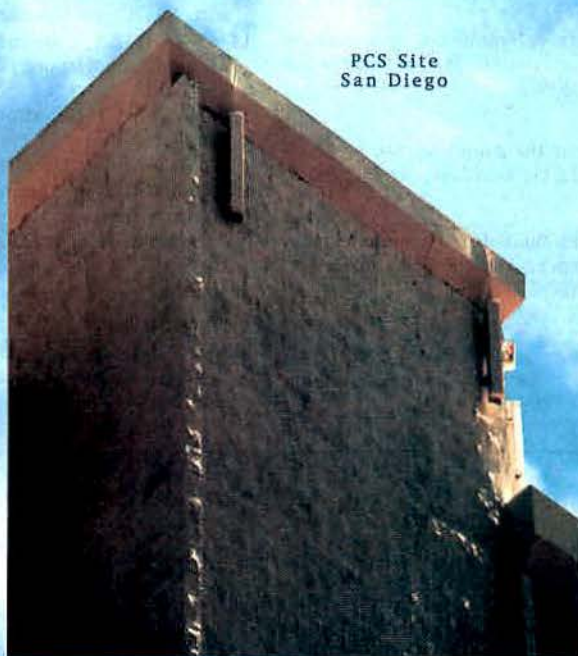
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### May

11-14—**Telecommunications Resellers Association Spring Conference and Exhibition**, San Francisco Marriott, San Francisco. Contact: Susannah Gaylord Stoll, 202-835-9898 ext. 3009.

18-21—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Westin Hotel, Ottawa, Canada. Contact: 908-562-3870.

20-22—**Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto, Canada. Contact: 613-233-4888, ext. 102.

### June

7-11—**Supercomm**, sponsored by USTA and TIA, Georgia World Congress Center, Atlanta. Contact: 1-800-278-7372.

7-11—**ICC**, the IEEE International Conference on Communications, sponsored by IEEE, Georgia World Congress Center, Atlanta. Contact: Debra Jordan, 404-529-5851.

28-July 2—**UTC National Conference & Exhibition**, sponsored by UTC, The Telecommunications Association, Hynes Convention Center, Boston. Contact: 202-872-0030.

### July

15-17—**Communications Expo/Show of the Americas**, Miami Beach Convention Center, Miami. Contact: Jackie Gonzales, 305-412-9000.

### August

9-13—**International Association of Public-Safety Communications Officials (APCO) National Conference**, Albuquerque Convention Center, Albuquerque. Contact: 904-322-2500.

### September

23-25—**Personal Communications Showcase**, sponsored by Personal Communications Industry Association, Orange County Convention Center, Orlando, FL. Contact: 703-739-0300.

23-25—**PCS Latin America**, sponsored by the Personal Communications Industry Association, Orlando, FL. Contact: Cathy Graham, 703-739-0300, ext. 3706.

### October

12-14—**Wireless Apps**, sponsored by the Cellular Telecommunications Industry Association, Bally's Las Vegas, Las Vegas. Contact: 202-785-2842.

14-16—**TelecomLatina**, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 1-800-288-8606.

19-21—**RF Design Conference & Expo**, sponsored by *RF Design* magazine, San Jose Convention Center, San Jose, CA. Contact: 1-800-288-8606.

### November

11-15—**Communications Marketing Conference**, sponsored by the Communications Marketing Association, San Diego Princess Resort, San Diego. Contact: Bernie Brownson, 303-371-8182.

12-13—**AMTEX**, sponsored by the American Mobile Telecommunications Association, Fontainebleau Hilton, Miami. Contact: 202-331-7773.

12-13—**Third International Congress on Commercial Trunked Radio**, sponsored by the International Mobile Telecommunications Association, Fontainebleau Hilton, Miami. Contact: 202-331-7773.

20—**Radio Club of America**, Communications Symposium, 89th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Gerri Hopkins, 908-842-5070.

## 1999

### February

8-10—**Wireless**, sponsored by the Cellular Telecommunications Industry Association, Ernest Morial Convention Center, New Orleans. Contact: 847-940-2155.



# Mobile Radio Technology

Technical information for paging, SMR and private wireless networks

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## Electromagnetic compatibility vs. mobile radio installations

By Harold Kinley, C.E.T.

With the proliferation of digital electronic control devices or electronic control units (ECU) within vehicles, the problem of electromagnetic compatibility (EMC) has really come to the forefront. How can all of these devices peacefully coexist within the confined space of vehicles? Now, throw in the mobile radio, with its relatively high RF power output and sensitive receivers, with an ever-increasing number of channels and range of operating frequencies, and the problem really gets complicated!

The problem is really a two-way (no pun intended) problem. That is, the radio transmitter can cause mild-to-severe degradation of the on-board electronics that control such things as ignition, braking and transmissions. Conversely, the ECUs might cause severe degradation to the mobile receiver. I remember a time when the communications technician only had to worry about a thing called *ignition noise*. And this only occurred at VHF low-band frequencies—right? Wrong. Contrary to some writings, the ignition noise problem could be severe at VHF high-band frequencies. Now that we have a multitude of other noise sources to concern us, the old ignition-noise problem pales in comparison.

### Electronic ignition systems

I remember my first encounter with the problem of the mobile radio transmitter interfering with the ECU that controls the ignition system of a pickup truck. The complaint was: "The engine stalls when I key the transmitter." It was one of those unusually cold January days in upstate South Carolina when I had to go out and check this problem. Like everything else that slows down in cold weather, my brain seemed to be no exception.

Anytime I have to deal with *intra-vehicular* interference, one of my first objectives is to determine whether the interference is *conducted* or *radiated*. It is important to make this determination because this factor determines how the problem is going to be attacked and, one hopes, solved. *Radiated interference* means that the interference is entering or leaving the radio antenna. *Conducted interference* means that the interference is entering or leaving via cables, usually the power leads.

My first test was to confirm the complaint, just to satisfy myself that the problem did exist. So, I cranked the truck and keyed the mobile radio transmitter. To my chagrin the truck engine *immediately shut down*.

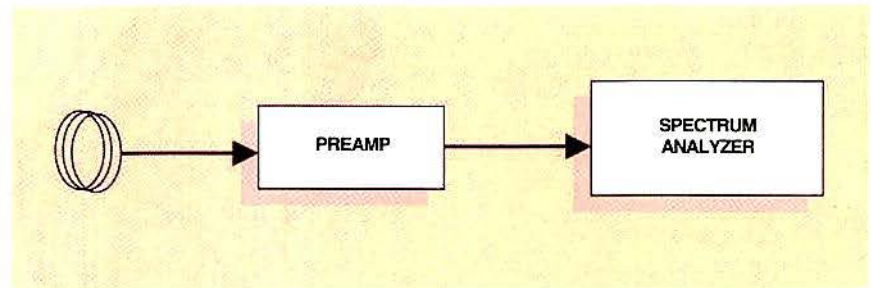


Figure 1. This setup is used to search out the source of the interfering signal on the vehicle.

This radio had been installed a couple of years ago by another technician and apparently had worked well for some time before this problem appeared.

Next, I removed the antenna connector from the radio and connected a dummy load instead. Again, I cranked the truck and keyed the transmitter. This time nothing happened—the truck ran on without skipping a beat. So, this interference was of the radiated type. The next step was to check the antenna. The forward-reflected power ratio looked good. The antenna was installed on the truck fender, next to the hood, so I raised the hood of the truck to explore underneath. I discovered that the antenna was sitting adjacent to the ECU that controls the ignition.

After this discovery, I suspected that the problem was the proximity of the antenna to the ignition ECU. Relocation of the antenna might solve the problem, but why had the problem just started when the installation had been working fine for some time? I quizzed the customer about the timing of the problem. Had anything been changed recently? Exactly when did the problem start? At first the customer expressed no knowledge of any changes around the time the problem started. But when asked specifically about the ECU he suddenly remembered that the ECU had been changed because of an ignition problem. Sure enough, that had been about the time the problem started with the radio.

The replacement ECU was apparently different from the original manufacturer's part. At this point, it appeared that the problem might best be solved by relocating the antenna to a point further away from the ECU. However, before spending more time in that miserable cold, I decided to try a cheap trick on a hunch. Using a piece of regular kitchen aluminum foil, I carefully wrapped all the wires entering the ECU. Then, to test the results, I cranked the truck and keyed the transmitter. To my delight, the truck *ran on*.

### Transmission ECU

Recently, a problem was discovered in an

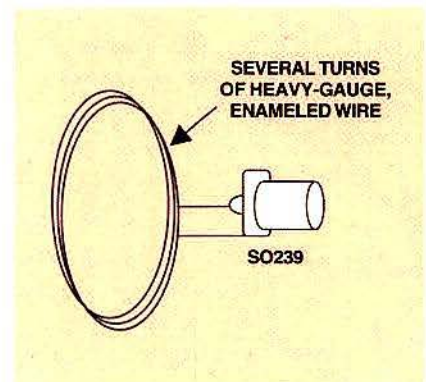


Figure 2. The pickup coil is constructed using several turns of heavy gauge enameled wire connected to an SO239 UHF connector.

International truck that is used to transport a crawler tractor used for forest fire suppression. The complaint was that something on the truck was interfering with normal radio reception on our state two-way radio receiver. The transceiver is a 32-channel VHF high-band with frequencies ranging from 151MHz to 159MHz. The interference was more severe on some channels than on others.

The first step in trying to resolve the problem was to determine the source of the interfering signal. The first possibility to come to mind was the ECU that controlled the engine. In order to search out the source of the interference, a Tektronix 495P spectrum analyzer was used with a *sniffer* probe attached, and a preamplifier was connected

(continued on page 52)

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyld Drive, Spartanburg, SC 29301. Kinley's email address is [hkinley@aol.com](mailto:hkinley@aol.com).



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# Gimme shelter: Alternatives for housing remote equipment

*'Alternative' equipment shelters can be steel, timber and concrete structures. They all serve the same purpose: protecting expensive radio equipment from the elements—and the perennial errant marksman.*

---

By Donald E. Koehler

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Many owners and operators of repeaters and mobile base stations dread the opening of hunting season. Although most sportsmen are responsible in their use of firearms, it is the few who inflict vandalism on remote equipment that cause the maintenance staff the most grief.

Vandalism to remote equipment is not limited to just hunting season. Unfortunately, in many areas of the Western United States, it is a year-round problem. Some sites are safe because of a location where access is restricted. Some sites are so remote that only a helicopter can easily get to them. (See "Helicopter Operations for Service Technicians," MRT, September 1996.) One type of location I was lucky enough to obtain in the past was a military surplus aircraft control and warning (AC&W) radar site. These sites were *secure*, with thick concrete walls and either fenced roads or fencing around the site itself. Infrastructure included power, telephone and alarm lines. Not every site has these amenities.

To provide a defense against both the "buckaroos" and the elements, remote shelters must be sturdy, yet as economical as possible to place at multiple sites. The following review discusses the kinds of shelters I have seen used for housing equipment in a rural or remote setting and gives two prefabricated "bullet-resistant" solutions that have worked well for me in the past. Finally, a type of shelter is examined that can be constructed on-site with a minimum number of workers.

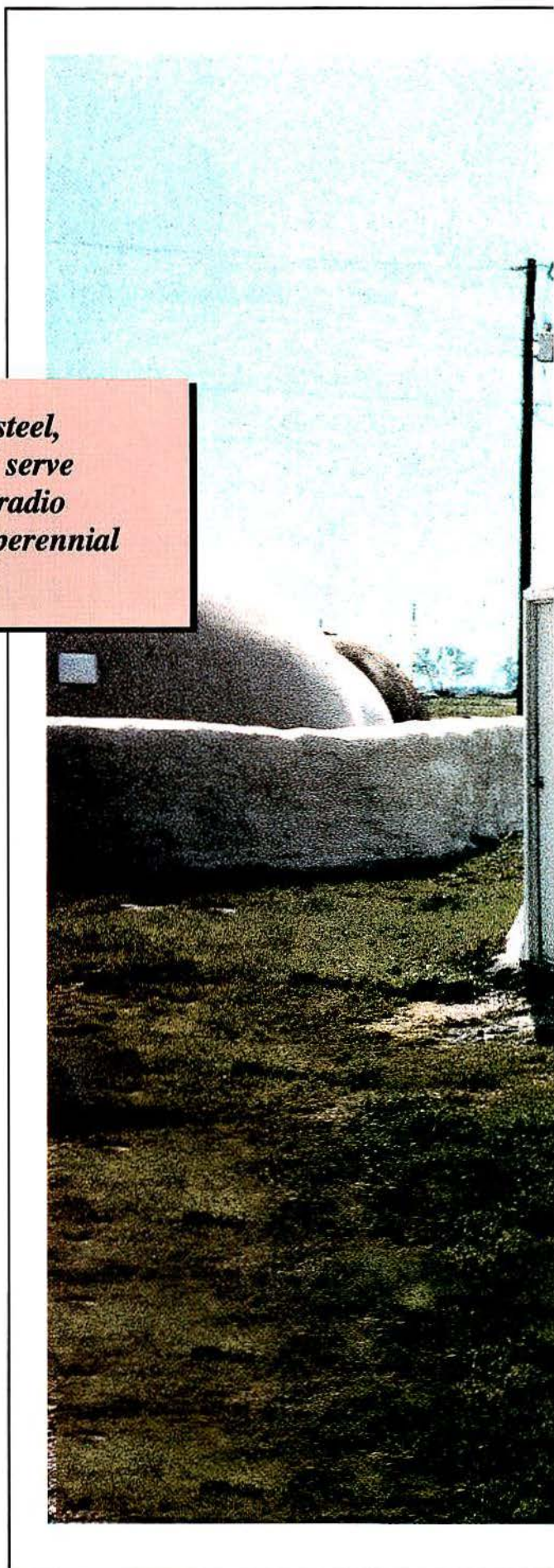
## **Any shelter in a storm**

In addition to standard, metal-framed and metal-sided buildings, I have seen log cabins, CONEX (metal ISO) shipping containers, plywood sheds, purpose-built metal cabinets and expensive cinder-block structures used to house radios. Oddest

---

Koehler, a long-time communications technician, now teaches at the University of Alaska, Anchorage. His email address is [afdek1@uaa.alaska.edu](mailto:afdek1@uaa.alaska.edu).

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Photos courtesy of Monolithic Dome, Italy, TX



of all was a (new) septic tank used to house radios, duplexers and the batteries to power the installed systems. Each of these shelters was intended to be cost-effective, to be easily built or installed on-site, to provide excellent environmental protection and, one hopes, to protect against theft and vandalism. Of the lot, the log cabin and the septic tank were the most successful—inasmuch as they were cost-effective and relatively easy to transport and to erect on site. They provided excellent physical protection, and they had space for both communications and power systems.

#### Engineering: From sanitary to radio

A new septic tank is relatively easy to convert into a remote equipment shelter. Usually made of reinforced concrete, it has holes cut out or cast in place for a pump-out and a connection to the leach field. Although the tank is designed to be buried, I recommend it be placed above ground. Once the tank is delivered and laid on its side, its access cover can be modified to provide rain protection and security. A new cover can be cast that incorporates a stout locking bar and that accommodates recessed "post office" padlocks. When covered by short strips of metal pipe, the padlocks are

proof against even large-caliber firearms. Sheetmetal strip-mounted above the entrance will keep the worst of rain and snow safely on the outside of the enclosure. Access for power and antenna cables is provided by use of thick-walled, "J-shaped," metal pipes mounted in the holes intended for the leach field piping. A set of flanges can be welded or bolted into the concrete to secure the cable entrance. Addition of silicon caulk makes for a drip-proof entry. Equipment may have to be broken down to pass through the small opening used as a door, but this is a small price to pay for a bullet-proof shelter. A good coat of paint seals the structure and helps to "blend" its visual signature into the local terrain.

An added benefit to using the heavy concrete tank structure is that it makes an excellent partial anchor for whatever tower you add to support your antenna. The only puzzle is how to mount your solar panels to allow maximum exposure to sunlight and minimum exposure to "stray" bullets. Mounts differ, but heavy metal plates—the size of your panels—will go a long way toward protecting your investment. A short "lip," about 3cm in height, around the panel edge adds to the shielding. Protection of interconnecting cables is up to your imagina-

tion—thick-walled metal pipe is an excellent protection, but it is expensive. All of these materials and the modified tank can be transported to your site on a trailer pulled by a pickup truck—and the trailer can be rented to further control costs.

The log cabin? It was pre-cut and assembled in the shop area. Once everything was fitted together, all the logs were marked and the shelter parts were moved to the final site—high in the mountains. On site, it was a simple matter to reassemble the shelter using hand tools. Standard roofing with sheetmetal trim completed the job. This particular log cabin shelter replaced a CONEX shipping container. The metal container worked well enough, but the flat "roof" leaked because of temperature changes through the seasons. If you plan on using a shipping container, give some thought to ventilation, to reduce condensation, before installing the equipment.

#### 'Rounding out' shelter types

A "different" kind of shelter, worthy of your consideration, is a concrete dome. Domes are usually used in large commercial or industrial construction, but smaller domes are now available for use as a remote equipment shelter. One specific product is the Ecodome structure

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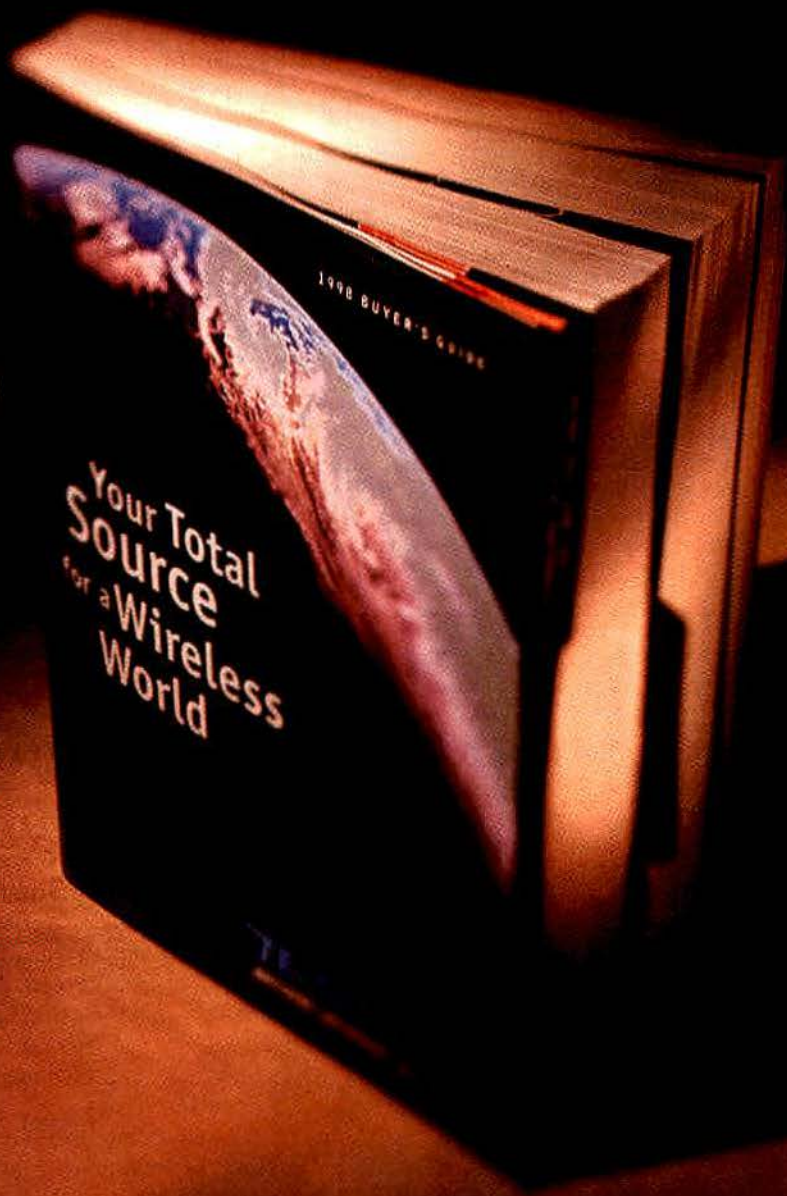


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from Monolithic Dome, based in Italy, TX. Attributes that make this a superior approach include the capability to build on-site with materials available almost anywhere. A variety of insulated and



When forming a Monolithic dome, a flexible membrane, the Airform air structure, attaches to the foundation and is inflated (with fans) into the chosen dome shape.

solid concrete domes can be purchased complete and transported to your site.

#### A 'radio dome,' not a 'radome'

The dome starts with a poured, circular foundation. This simple pad includes reinforcing steel bars (rebar) that strengthen it and that provide "tie-in"

points for the remainder of the structure. Next, a flexible membrane, called an Airform air structure, is attached to the foundation and inflated with fans into the chosen dome shape. Several variations are possible. Rebar is woven and tied on the outside of the inflated dome in a pattern like the intersecting latitudinal and longitudinal lines of a map globe. Because the overall height of a small dome is no more than an average room, the top of the dome can be reached with a ladder. The inflated air structure is able to support several workers at the same time. Concrete forms are added around the air structure collar or other locations for doorway construction. Once the rebar is woven and tied, pressurized concrete, referred to as "shotcrete," is sprayed in stages over the resulting structure. The worker sprays the concrete in layers. If a larger dome is required, temporary scaffolding can easily be erected as a gunner's platform. The process is repeated as needed on the inside of the structure, when the air structure is removed, to completely cover the rebar and to allow finishing of the concrete. The photo on page 11 shows the finished product, complete with doorway and roll-up garage door. When the concrete is cured,

the air structure can be recovered and used to build additional domes.

When using this type of concrete dome construction for communications shelters, some advance planning can save steps and expense. When laying out the foundation, include excavation for the base of any adjacent tower you have planned. Then the foundation and the tower base can be done as a single pour, reducing the time and expense for the on-site work. The entrance or doorway should be offset, or "L-shaped," to prevent wind or rain from blowing directly onto the equipment when the door is opened. This approach, and a thick metal door, goes a long way toward shielding your equipment from damage. An even better solution would be to use a roll-down metal shutter over a heavy door. This type of construction allows a lot of latitude in how the structure is built.

Monolithic Dome operates a training academy, the Monolithic Dome Institute, where this type of construction is taught through a combination of classroom and hands-on lessons. More information can be found at Monolithic's Web site, [www.monolithicdome.com](http://www.monolithicdome.com), or the company can be reached at 972-483-7423.



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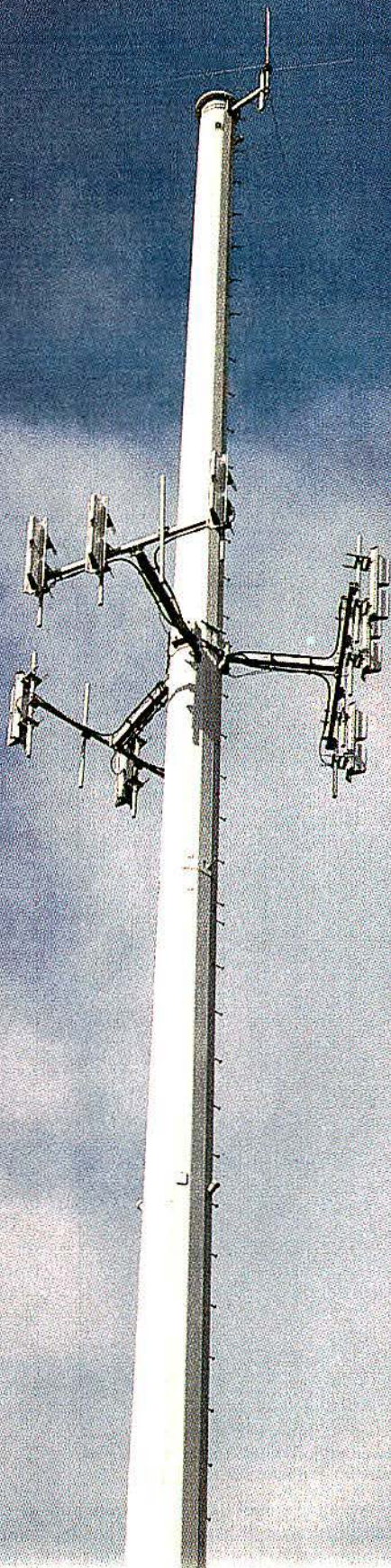
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# Advances in police tactical communications

*Headgear and encryption devices lead the way.*

By Michael J. Major

During the period of the notorious gangs in the '20s and '30s, the police rejected the then "new-fangled" technology of two-way radios as being somehow outside the realm of established procedures. The gangs, however, were not hung up by such bureaucratic considerations, and in many cases used the new technology to run circles around the police.

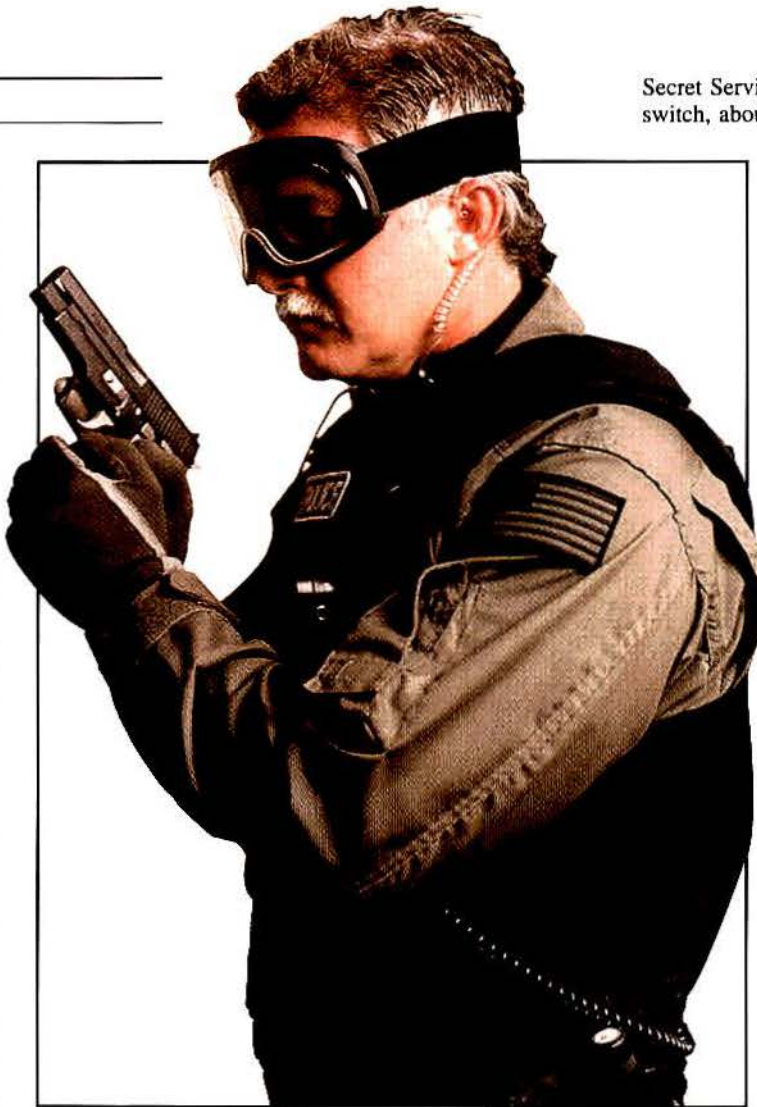
Well, the police have long since learned their lesson and have eagerly embraced the most up-to-date technologies. Two of the hottest areas of tactical police communication are headgear and encryption.

## Headgear

Tactical communications headgear is a specialized area; only a few manufacturers make these devices. One is Television Equipment Associates (TEA), South Salem, NY. This company's product line represents the general trend in how some of the most advanced gear is deployed in this tactical communications.

TEA's LASH headset was specifically designed for the Los Angeles police special weapons and tactics (SWAT) division, said TEA President Bill Pegler. The headset has a strap, which goes around the neck, and inside the strap is a nozzle module near the voice box.

Major is a writer in Anacortes, WA.



Tactical communications gear keeps police operations silent and adds to officer safety. (Photo courtesy of Television Equipment Associates.)

"Because the nozzle is near the voice box, it's impervious to any other noise," explained Pegler. "You can stand directly under a helicopter and the person at the other end will hear you, but not the helicopter."

The radio signal is received at a module in the strap and is directed to the ear through a small coiled plastic waveguide, similar to the familiar devices worn by actors playing

Secret Service agents in movies. The PTT switch, about the size of a silver dollar, is clipped onto the chest.

"You can key the radio 'on' with your underarm, elbow or wrist," said Pegler. "You don't have to grope around."

A separate PTT switch can be fitted to the stock of a sniper's rifle.

"It looks like a flat, string bean, finger-tip button on the end of a cable," Pegler said. "Typically, both hands are on the weapon, but one finger can easily reach this button." The sniper button is redundant to the chest clip-on switch.

In the LASH headpiece, the coiled tube is held to the ear by a skeleton ear mold. In another headset, however, called TASC, a thin earphone, less than 0.5" thick, fits over the left ear and beneath the ballistic helmet.

"In the side of this little earphone there are holes, the purpose of which is to accommodate peripheral hearing," Pegler said. "Because in close-quarter battle, the person needs to hear out of both ears and have all of his senses alert."

Pegler added that the skeleton ear mold in the LASH accomplishes the

same function as peripheral hearing. The TASC has the same PTT arrangements as LASH, but differs in that it has an adjustable boom microphone, which locates at the corner of the mouth.

The newest TEA headset is LITE, which was developed for the military Special Forces. It looks like a second cousin to the TASC, with a similar thin earphone.



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"The difference is that on the back end of the boom arm is a socket which allows you to plug in either a throat mike or a mask mike," Pegler said. "The point here is that this product is a combination of both LASH and TASC, for we attempted to give the best advantages of both."

Pegler explained that the TASC boom arm provides the best possible sounding microphone, but that will not do you much good if you have to put on a gas mask that covers

your mouth. In a military or riot situation, the LASH throat microphone, on the throat rather than the face, is more suitable. The headset allows the wearer to use the boom arm until gas is deployed, then the boom is disconnected to allow for the mask mic that plugs into the voice emitter of the gas mask.

Another TEA headset is Collar Set III, which Pegler said was designed not as a SWAT headset, but rather as a surveillance headset. Even SWAT police spend most of

their time on surveillance or protection activities. The collar set is often chosen by departments as a more general-purpose unit.

The unit is also "lower tech" and less expensive. The radio can reside on either the body or belt, and just a single wire can be routed underneath the clothing, terminating in a flat 0.5" x 2" device that can be worn under a shirt, positioned over the collarbone. The talk switch can be in your hand-held or placed on the belt.

"When you want to talk, you just press a button and don't have to talk into the microphone," Pegler said. "Since the microphone is under the shirt, you can communicate without seeming to be using a radio." Headgear radios range from about \$400 to about \$700, with Collar Set the least expensive and LITE the most expensive.

### Encryption

"Public safety in general, and SWAT teams in particular, are looking for higher levels of security in their communications," said Jeff Good, director of analog sales, RELM Communications, West Melbourne, FL.

Good explained that there are three main types of encryption products on the market, all of which are sold by his company.

The first is the traditional analog type, which, has, nevertheless, grown more sophisticated over recent years.

"These started out with several voice-inversion encryption scramblings, which then evolved into rolling code, which basically changes the length of time of a frequency duration and, secondarily, masks the tone over the conversion frequency," Good said.

The next level is digital encryption, several varieties of which are available on the market. The most common is *data encryption standard* (DES). DES was developed by NASA and then refined by the National Bureau of Standards.

The third type of encryption is spread spectrum or frequency-hopping.

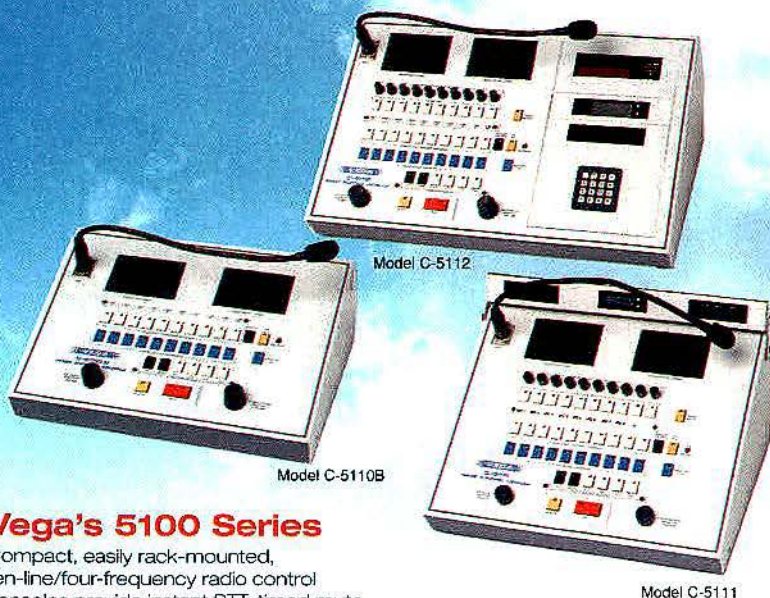
"If I'm a criminal and have a scanner and hear someone talking, I may not hear what is being said if it's encrypted, but I do know there is an operation in the area," Good said. "But with a frequency-hopping device, he would not pick up the signal at all, so I would have a silent footprint."

Analog is the least expensive, while DES and frequency-hopping are about the same stepped-up cost.

"Usually the question is not so much price as the level of security that is required," Good said. "Frequency-hopping is the least susceptible to jamming and interception, so should be the most secure."

Jeffery Fuller, president of Trancrypt International, Lincoln, NE, said that an interesting new hybrid combines analog and

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digital technologies. The reason is that the majority of systems' infrastructure is still analog, and is not likely to be displaced soon by digital. Analog radio frequency (RF) equipment is much less complicated and less expensive than digital. However, Fuller explained, it is possible to use digital encryption techniques and algorithms on analog.

"There will still be a high demand for high-level analog encryption until the world catches up with digital," Fuller said.

The overall need for security is increasing every day, especially since more and more information is being shared among departments, agencies, and even different governments, through wireless and computer data. Fuller said that the prices for upper-level technology stay high because of the ongoing advances, while the prices are falling for the lower, less advanced levels.

Another driving force behind the ever-improving, higher-level technologies is that

criminals have access to the same technology. They challenge the existing protections, which, in turn, challenges law enforcement agencies to innovate anew.

"It's been mostly *quid pro quo*. We haven't gained, but they haven't either," Fuller said.

Privacy issues are also driving the need for more and better encryption devices.

"If someone hears an arrest warrant being issued and somebody publishes it, that can be a lawsuit," Fuller said.

Paradoxically, the necessity to communicate quickly is being accompanied by a

*'There will still be a high demand for high-level analog encryption until the world catches up with digital.' — Fuller*

corresponding necessity to make that same message "incommunicable."

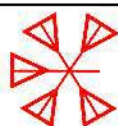
#### The fight for spectrum

"None of the new headset, encryption, or other technologies will work without spectrum, and public safety is in dire need of spectrum, both for tactical and administrative purposes," said John Ramsey, deputy executive director, Association of Public Safety Communications Officials—International (APCO).

For this reason, Ramsey explained, one of APCO's main priorities is for spectrum. Video and high-speed data equipment require a broader spectrum, and new narrowband channels are coming to the forefront. "We are fighting for all of them," Ramsey said.

The battle is not necessarily a losing one. For instance, as the result of the introduction of digital TV, UHF television broadcasting channels are being refarmed back into the radio pool.

"Currently we have none of those channels, but we have asked for 24, and it looks as though the FCC is going to give them to us," Ramsey said at the beginning of the year. "The reason is that FCC has been mandated to do so by Congress, for we were successful in convincing Congress that protecting property and savings citizens' lives was a public priority. If we had not fought for these channels, we would very likely have gotten nothing."



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# It's 2:30 a.m.; Do you know where your paging system is?

*Even large paging operators cannot baby-sit a system 24 hours a day. Remote monitoring detects and announces problems before they become catastrophes.*

By Vaughn Enwistle

It's 2:30 a.m. when the phone next to Alan Gilmour's bed starts to ring. Gilmour is the vice president/operations manager of Sprint Paging, a large paging system operator in Victoria, British Columbia, Canada. Gilmour does not like being awakened from sleep by a jangling phone any more than the rest of us, but this is one call he is grateful to receive. When he picks up the receiver, the voice on the other end of the line is familiar—very familiar. In fact, it is his own voice, a recording being played back by a remote paging monitor. The prerecorded message informs him that a major part of Sprint's system has just gone down, and it gives him the location. Gilmour holds down the star key for a couple of seconds to cancel the alarm. Then he hangs up and dials BC Tel, his local telephone company.

At 2:30 in the morning, 20,000 other BC Tel customers who have lost their phone service do not know it yet. Even BC Tel does not know. Gilmour is about to enlighten them.

## Ditch the switch

Gilmour describes what happened on that long, sleepless night: "BC Tel had just replaced one of their major switches. It was a switch they weren't familiar with, and they didn't realize they had programming problems until we called in. Once they started looking at our problem, they found other problems. The situation spiraled downhill from there.

"At five in the morning, while I was waiting for the phone company to call me back, I decided to call into my Internet provider and found that his system also wasn't working." Gilmour was able to pass on the unhappy news to his Internet service pro-

vider, who otherwise would still have been in the dark.

## First come, first served

Most importantly, the fact that Gilmour was the first to call into BC Tel meant that Sprint Paging was the first subscriber to get fixed.

"We were up and running three hours later," Gilmour said. "By six in the morning, when our customers started to use their pagers, they had no idea there had ever been a problem." Sprint's customers were the lucky exception; 10,000 BC Tel customers still did not have their phone and paging service fully restored until three days later.

## An ingenious modification

Gilmour had specially modified a model 1512 Zetron Sentridial monitor so that it could monitor paging transmissions and provide dial-out voice alarms in the event of a system failure. "We took a model 1512 and added some external timer circuits and a pager," Gilmour said. "We wrote a dial-in

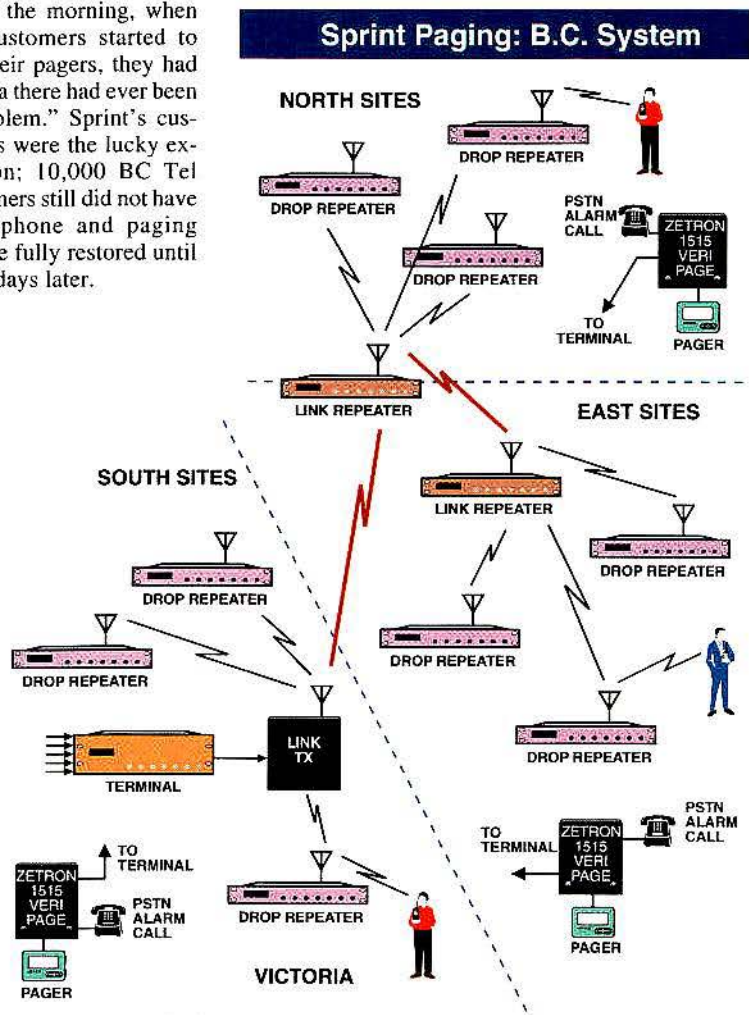
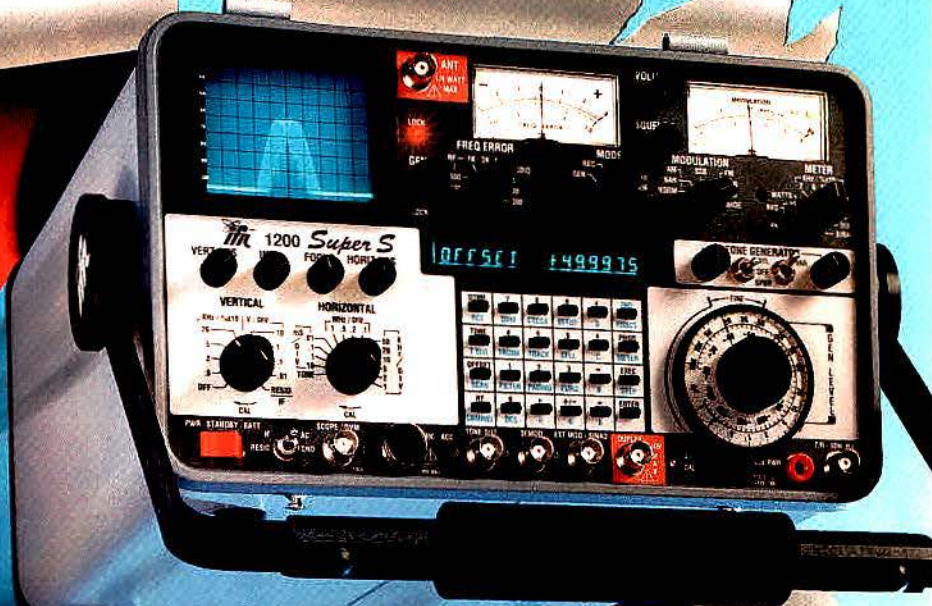


Figure 1. Distributed monitoring for Sprint Paging's system.

Enwistle is the editor of *Advantage* magazine for Zetron, Redmond, WA.



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loop and then an alarm sequence once that loop was broken for any length of time."

The modified monitor worked like a charm. Gilmour described his innovation to Zetron engineers while visiting the company's booth at a Canadian Wireless show in Vancouver. As a result, Zetron developed and refined Gilmour's idea into the new model 1515 Veripage monitor. The system is set up with a vibrating pager, of any make, connected to a verifying monitor

located inside the coverage area. The verifying monitor dials a paging terminal at user-defined intervals to activate the pager to which it is connected. The monitor detects when the pager receives the signal and resets its interval timer until the next page. If the page is not received within a reasonable amount of time, the verifying monitor automatically dials as many as 10 preprogrammed telephone numbers to deliver voice, numeric or alphanumeric mes-

sages to maintenance employees.

#### Number one on the List

The modified monitor at Sprint Paging is set up in a similar fashion. When an alarm occurs, it follows a preprogrammed dialing list, calling technicians' homes and cellphone numbers until the alarm is acknowledged. Not surprisingly, Gilmour's name is number one on that list.

Gilmour explained why he created the automated alarm system in the first place: "We've got a very well-designed system at Sprint Paging, but we've got no operators or answering service—everything is strictly direct-dial into the paging terminal. After hours, our telephones are call-forwarded to our pager, so if we had a major system outage it would be very difficult for us to find out about it. It's not like we have an operator on duty 24 hours a day who can start phoning us. Basically, the model 1512 gives us peace of mind. It has been in place for two years now. We've had a couple other incidents, but this was one of the first real major outages since the system was installed."

#### Sprint Paging

A division of Sprint Radio Systems, Sprint Paging is the largest independent paging provider in that area of British Columbia, with several thousand customers in a coverage area spread across Victoria, Vancouver Island and greater Vancouver. Sprint's paging system relies on an automated, high-end paging terminal with links to repeaters in each of its service areas. To provide complete coverage, Gilmour has a total of three modified monitors in operation, as shown in Figure 1 on page 22.

"We've got one of these units in each different sector of our paging system, because Victoria could be fine, but if one of our links goes down it could take out half a dozen sites somewhere else," Gilmour said.

The monitor for Sprint's Victoria service area is located at Gilmour's home. "I've got the unit located off-site, so it does a full check-out of the system," he explains. "It phones in the trunk lines and tests right from end to end. If it was located at our terminal unit, we could use it for some external reset or switchover function."

#### Better than insurance?

Gilmour may have lost a few hours sleep during that night, but his company did not lose any revenue. Thanks to his ingenious modification of an existing autodialer, Sprint Paging's customers did not have to wait three days before they could use their pagers again. Having an electronic watchdog to sound the alarm will make any paging system manager sleep a little easier.



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# Microwave path design: The basics

*Part 1 — This four-part primer on propagation-related basics, for those learning about microwave communications, begins with “line-of-sight” determinations and the evaluation of path clearances with regard to refractive effects.*

By Jeff Ashley

Microwave communications path design poses many challenges. In addition to *static gain and loss* considerations, *terrain and propagation dynamics* can play a large role in determining whether a proposed path will have the required signal levels, clearances and reliability.

This four-part series will only scratch the surface with regard to these considerations, and it is not intended to cover *all* aspects of path design or any one in great depth. The primary focus of the series is to serve as a primer on some of the propagation-related basics for those who may be new to the microwave communications field.

Given this disclaimer, the following tasks are some of the fundamental compo-

nents of microwave path design:

- ☐ determining whether a proposed path is “line-of-sight.”
- ☐ evaluating path clearances with regard to refractive effects.
- ☐ evaluating path clearances with regard to Fresnel zones.
- ☐ considering path reflections.
- ☐ deriving a power budget and the fade margin.
- ☐ path reliability.

Part 1 of this series deals with the first two components; the others will be discussed in Parts 2, 3 and 4.

## Determining line-of-sight

Although there are situations where microwave paths are designed to work without line-of-sight conditions, they would not be considered the “norm” for industrial micro-

wave systems and therefore will not be dealt with here. In most situations, if a prospective path is not line-of-sight, then an alternate route is considered.

Determining whether a path is line-of-sight can be partially accomplished with the aid of a *topographical map*. This type of map will show the various elevations along the length of the path between proposed endpoints. Plotting these elevations at intervals will produce a path profile showing terrain relative to the antenna elevations, as shown in Figure 1 below left. This graphical representation aids in determining not only whether a line-of-sight condition exists between endpoints but also in measuring clearances between the main beam (center) of the path and the surrounding terrain.

Topographical information for many areas throughout the world is now available on CD-ROM. Various software applications have been developed to design microwave paths based on this information. Since this option can be a bit “pricey,” many opt to use inexpensive topographical maps, which may be used with the same success.

When evaluating a proposed path, the *path profile* should be developed first. This will identify path obstructions from terrain features. A field survey should follow, which offers the necessary visual confirmation that the height of foliage or of man-made objects (which are not indicated on a topographical map) will not be located in or too near the proposed path.

If visual confirmation is difficult because of the distance between path endpoints, a mirror can be used to reflect the sun’s light from one path endpoint back toward the other. If the mirror’s flash of reflected sunlight is seen back at the opposite endpoint, the path is line-of-sight. This is referred to as “flashing” a path. Alternate methods

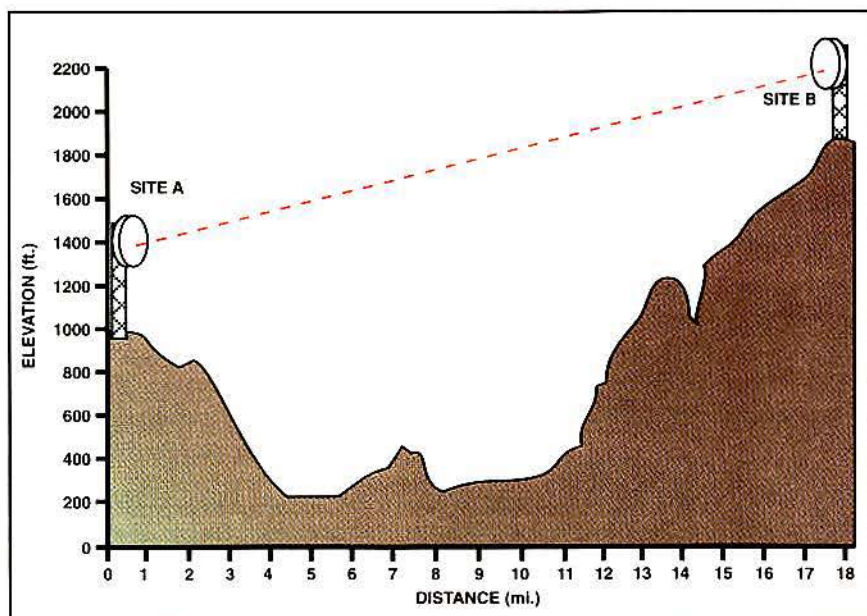


Figure 1. A typical path profile indicates terrain elevations relative to distance along the length of the path.

Ashley is a communications technician in Los Angeles.



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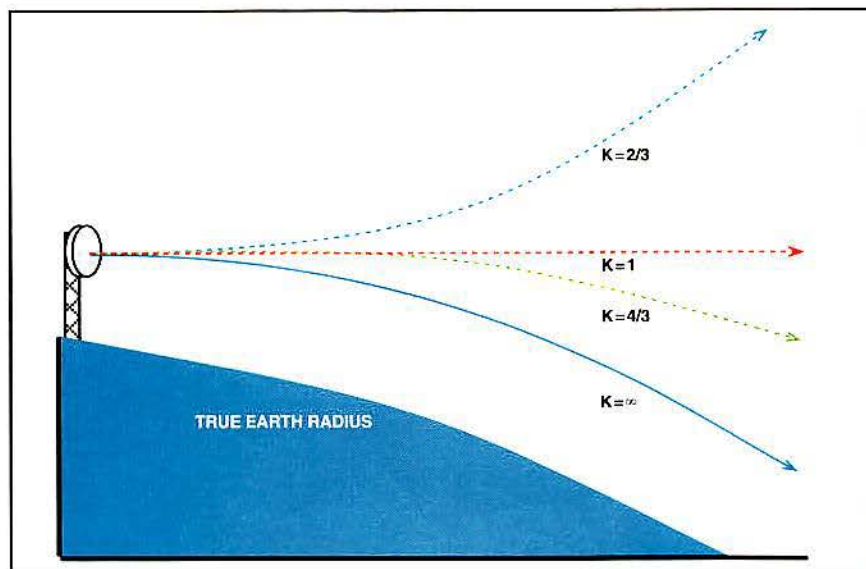


Figure 2. Where  $K$  equals infinity, the wavefront parallels the radius of the true earth. When no refractive effects are present ( $K = 1$ ), no bending of the wavefront occurs.

might include the use of high-intensity search or strobe lights.

#### Evaluating path clearances—refraction

When the *dielectric constant* of the atmo-

sphere changes with height-above-ground, the *refractive index* will also change. This refractive variation in turn causes the propagating wavefront to effectively "bend." If a condition exists where the dielectric constant

of the atmosphere is constant with height-above-ground, no refraction will occur and the wavefront will travel in a straight line. This is not the "norm," however. Because of dielectric variations typically present, a wavefront usually will be refracted so that it will follow a path somewhere between a straight line and the true curvature of the earth (referred to as  $R$ ). A wavefront propagating through the environment will be slowed by, and be effectively bent toward, an atmosphere that is more dense, such as one with a high water-vapor content (dense clouds or fog). That is why, rather than traveling in a straight line, the wavefront is normally bent earthward—which serves to extend its horizon.

Because atmospheric conditions are dynamic, the bending effect of the propagating wavefront will vary. To provide a simple model describing the path traveled by a wavefront for a particular refractive condition, engineers have developed a factor,  $K$ , where  $KR$  is considered the "equivalent" earth radius. This equivalent radius describes the bending of the wavefront relative to the true earth radius, as shown in Figure 2 on page 28.

The refractive index can change

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drastically with time. This means the microwave beam between path endpoints will "bow" to a greater or lesser extent. In fact, it may "bow" in an upward or a downward direction, depending on the value of  $K$  at the time. It is therefore important to evaluate clearances from path obstructions over a wide range of  $K$  in order to determine whether adequate path clearances are maintained under various degrees of refraction. Often, three values of  $K$  are used in the calculations. Two of the three values describe the limits or boundaries of refraction that might occur (although with anomalous conditions, values exist outside these limits), while the third describes what is considered "normal" or expected. The value of  $K = \infty$ , also known as "super-standard" atmosphere, is one extreme where the wavefront follows the true curvature of the earth. The other extreme value of  $K$  typically used is  $2/3$  and is termed "substandard" atmosphere. It is also a condition commonly referred to as "earth bulge." The median value of  $K = 4/3$  is used to evaluate the path under "normal" atmospheric conditions in temperate climates.

There are two methods of graphically displaying the various equivalent earth radii

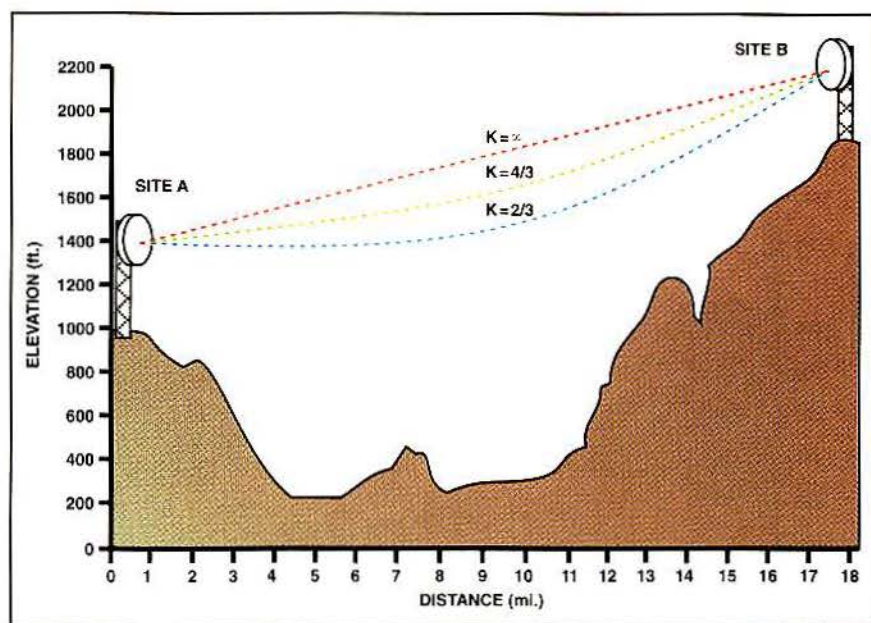


Figure 3. This is a 'flat-earth' profile. Terrain features become more of an obstruction consideration when  $K = 2/3$ .

with respect to the terrain between path endpoints: the "flat earth" method and the "curved earth" method. Figure 3 above is an

example of a "flat earth" path profile. It is called "flat earth" because the horizontal axis (or baseline) has been kept flat and

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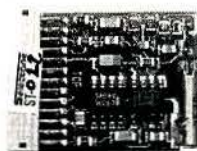
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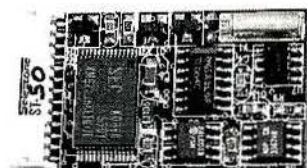
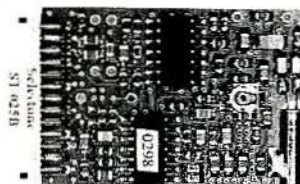
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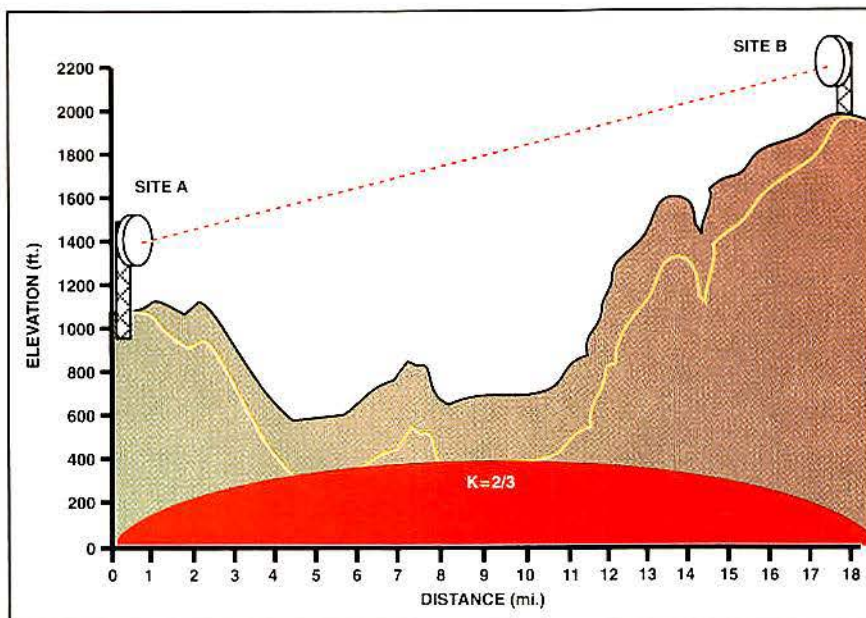


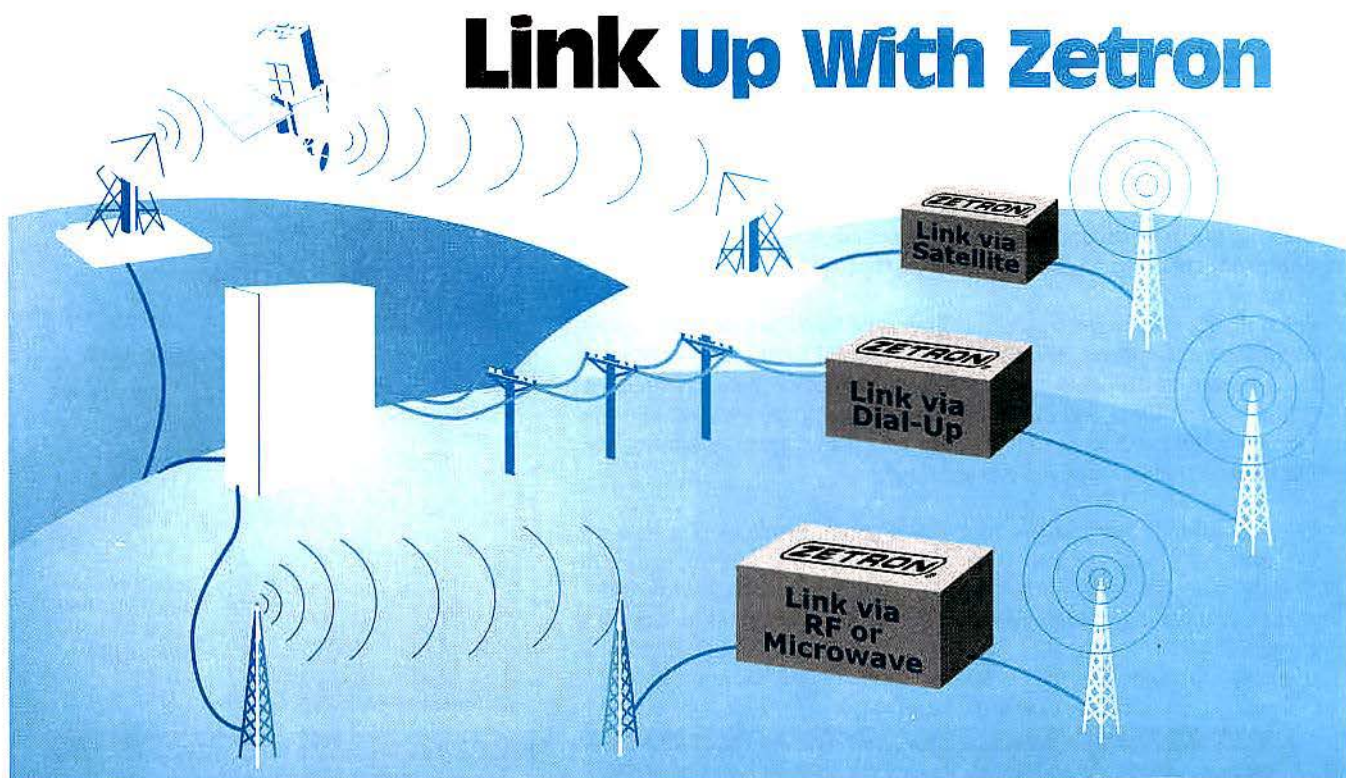
Figure 4. This is an exaggerated curved-earth profile where  $K = 2/3$ , with identical terrain features as shown in Figure 3. (Figure 3 elevations are represented by the yellow line.) Because the equivalent earth radius 'bulges up' in the center, the elevations of the terrain features increase, *reducing* path clearances. When  $K = 4/3$ , the earth bulge is less severe, resulting in greater path clearances. The greatest clearance is realized when  $K = \infty$ .

represents the earth's curvature as a flat line. The various equivalent earth radii represented by the different values of  $K$  are shown by bending the path beam line between antennas. The three lines shown in Figure 3 correspond to the refractive conditions where  $K = \infty$ ,  $K = 4/3$  and  $K = 2/3$ .

Elevations of terrain features between path endpoints are plotted using the flat baseline as a reference. The profile allows one to see if there is sufficient path clearance over the terrain for each value of  $K$ .

The curved earth approach, as shown in Figure 4 on the left, leaves the beam line between antennas straight and instead bows the horizontal baseline to correspond to one particular value of  $K$ . Elevation of all terrain features must be added to that of the bowed baseline reference. The straight beam line between antennas must now be checked for sufficient clearance from all terrain features for that value of  $K$ .

With the curved earth profile, the one limit of  $K = \infty$  would be shown with the baseline flat. Here (as with the flat-earth approach) is the one "extreme" condition where the wavefront (shown as a straight line) follows



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the true curvature of the earth (also shown as a straight line). As the value of  $K$  gets smaller and reaches the other limit of  $K=2/3$ , the equivalent earth radius bulges upward more in the center, hence the term "earth bulge." As these profiles show, paths with values of  $K = 4/3$  and  $K = 2/3$  have less path clearance with respect to terrain features than when  $K = \infty$ .

The following equation can be used to calculate how much the horizontal axis (or

baseline) of a "curved earth" profile will bow upward at any point along the path for a particular value of  $K$ :

$$h = \frac{d_1 \times d_2}{1.5 \times K}$$

where  $h$  is the vertical variation in height (ft.).

$d_1$  is the distance (mi.) from one end of the path to the point being considered.

$d_2$  is the distance (mi.) from the point considered to the other end of the path.

With the "flat earth" profile,  $h$  is subtracted from the direct ray ( $K = \infty$ ) reference line (for positive values of  $K$ ) at various distances along the path in order to develop a graphical representation of the amount of wavefront bowing that will occur for the value of  $K$  under investigation.

With the "flat earth" profile, the wavefront, rather than the baseline, is shown "bowed," and the amount of bowing changes as the value of  $K$  changes. The distance between the bowed wavefront and the terrain features can be measured graphically to determine path clearances for each value of  $K$ .

Whichever profiling method is used ("curved earth" or "flat earth"), it can be seen graphically that smaller values of  $K$  result in greater bulging or "bowing." This in turn

... Smaller values of  
 $K$  result in greater  
bulging or 'bowing.'  
This in turn results in  
less path clearance ...

results in less path clearance with regard to terrain features.

Because the microwave path has *radial dimension*, the clearances considered are not only those above and below the center of the path, but also to either side.

Initially, these graphical methods allow path clearances to be measured as distances, in feet. Once this information has been obtained, it is however, typically converted to a more meaningful design measurement, called the *Fresnel zone*.

The next article in this series will discuss path clearances with regard to Fresnel zones.

#### References

- Laine, R.U., *Determining Antenna Heights for Coastal Areas*. Lenkurt Electric, Monograph 197.
- "Microwave Systems, Microwave Path-Testing," *Bell Systems Practices*, AT&T Standard, September 1962.
- "Microwave Transmission Engineering (Part One and Two)," *GTE-Lenkurt Demodulator*, July/August, 1972.
- White, R.F., *Engineering Considerations for Microwave Communications Systems*, 4th Ed., GTE-Lenkurt, San Carlos, CA, 1983.



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# Radiating cable improves in-building wireless



*Coupled with a DECT-standard system, radiating cables reduce the required number of base stations and extend coverage into interior spaces.*

By Klaus Haas and Gregor Veithen

Wireless communications systems are becoming increasingly important, both to business and personal life. It is equally important that they *work* everywhere that people go. For system coverage in open areas, antennas are almost always sufficient. In buildings and other enclosed areas, there are frequently difficult propagation issues, making coverage of the interior spaces by exterior-mounted antennas inadequate. This not only limits communication, it can limit revenues for systems providers.

There are several ways to achieve better RF coverage within a building or other interior space. One method is to point an outside antenna at the structure. Depending on the structure's composition (wood, brick, stone, concrete, steel, glass, etc.), directed RF will vary in effectiveness. Another method is to mount an antenna inside the building. Again, effective coverage depends on the RF-shielding properties of the interior walls. If long corridors or tunnels are involved, the RF energy will usually not propagate far along their length. Many antennas and many radio base stations, at great cost, may be required to achieve good coverage.

The preferred solution to achieving RF coverage in interior spaces is the use of a *radiating cable*. This cable is designed to couple energy along its length. In effect, it acts as a long, low-gain antenna. The net effect is that the cable loss is increased only slightly, compared to a conventional coaxial cable, while enough energy is coupled to the

environment to achieve good RF coverage in virtually any configuration of interior space. With a radiating cable, a single base station may be able to provide coverage over a large area, reducing the cost of system implementation.

In the trial installation described here, a new-design radiating cable was evaluated. The balance between downline attenuation and coupling to the environment is controlled by the design of the outer conductor. For applications in subways and tunnels, where the lengths of cable used may be several kilometers, the downline attenuation must be minimized to produce sufficient signal at the end of the run.

For a building application, where the runs are rarely more than a few hundred meters, a different balance between downline attenuation and coupling to the environment is required. There, the attenuation of the cable can be somewhat higher, while a greater degree of coupling to the environment is desirable, to help the signal to penetrate walls, floors and partitions.

Digital enhanced cordless telephone (DECT) is a reliable standard for cordless telephony that is commonly used in many parts of the world. It operates on a frequency range of 1,880MHz–1,900MHz, and the radiated power is 250mW. The mean coverage area typically extends about 50m from the antenna in an indoor application and about 300m in an outdoor application.

To cover a large indoor area, several base stations or repeaters are required. A central

unit controls the base stations, centralizes the communication control and achieves a real network with roaming and seamless handover between cells. In this way, the DECT system is similar to other cellular and PCS systems in use today.

Because the DECT system allows the use of multiple cells coordinated together to allow hand-offs, it can be used to cover virtually any

*With a radiating cable, a single base station may be able to provide coverage over a large area, reducing the cost of system implementation.*

area. When a customer orders a system, the requirement is usually to cover the entire facility. This will frequently include areas such as store-rooms, basements and garages, where there are few users and there is little demand for capacity. With a standard antenna-

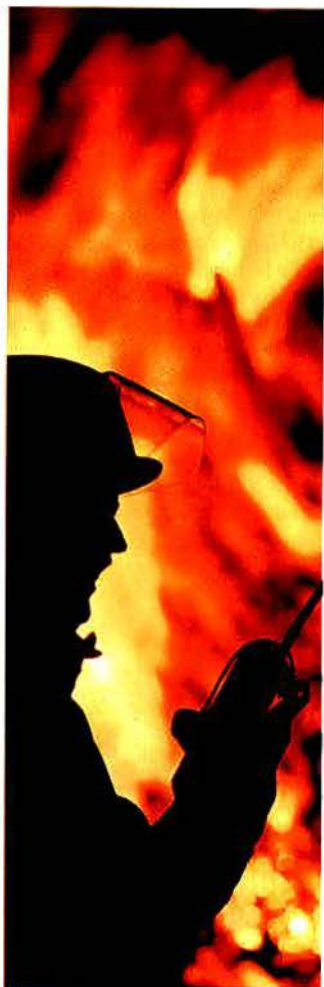
based system, a separate base station usually will be needed to overcome the RF shielding of these areas.

A large paper factory with a total area of 5 million square feet required 63 base stations to achieve coverage using a conventional antenna-based system. Because base stations are expensive (and because in many cases they still do not give good RF coverage in an enclosed area), a trial was undertaken on the use of radiating cable in a DECT

Haas is RF sales manager and Veithen is RF engineer for Kabelwerk Eupen A.G., Eupen, Belgium.



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system at the Kabelwerk Eupen factory, Eupen, Belgium.

Each base station has two antennas to provide space diversity, increasing the quality of the communications. The signals from the two antennas are compared, and the better signal is used by the system. The antennas were replaced by radiating cables in several configurations, with good results. In order to match the coverage achieved to the space, the following configurations were tried:

□ Radiating cables were attached to each of the two antenna ports, run in opposite directions. This eliminates the diversity and allows the largest area to be covered by the base station. It results in some degradation in signal quality because of the lack of diversity, but may be suitable for some rarely used large areas.

□ Radiating cables were attached to both antenna ports and run in parallel. This provides the best performance, because of the

cable diversity. It is the best solution for heavy traffic areas where there is frequent use and quality of coverage is important, such as heavily used corridors or tunnels.

□ An antenna was attached to one port, and a radiating cable was attached to the other. This allows the use of a single base station to cover a large open area and an adjacent hallway or corridor.

By carefully combining these configurations, the number of base stations required to implement a system can be reduced by more than half, depending on the building layout. The quality of the coverage achieved will usually be much better in a system with radiating cables. There is also a reduction in system complexity, increasing its reliability and decreasing maintenance requirements.

An omnidirectional antenna radiates equally in all directions and would be the best solution to cover a single, uniform room. Radiating cables provide a good solution to cover a long corridor, a great hall with several obstacles, or several rooms with the same communication cell.

Radiating cables transmit the signal in their longitudinal direction and simultaneously radiate a part of the energy along their total length to the surrounding area. Also, the reception of a signal from the outside is possible. Radiating cables can be considered as elongated antennas that are

*Radiating cables can be considered as elongated antennas that are specially appropriated for long, extended areas.*

specially appropriated for long, extended areas. Currently, most radiating cables are used for mobile communications in tunnels, subways and mines, but the development of new in-house radiating cables also permits their use in buildings.

By using radiating cables, wireless coverage within buildings can be accomplished in a way that is more economical and more complete. The amount and complexity of the base station equipment required can also be reduced, resulting in a more reliable system requiring less maintenance over time. When combined with conventional antennas, radiating cables provide an excellent tool for the designer of indoor wireless communications systems.



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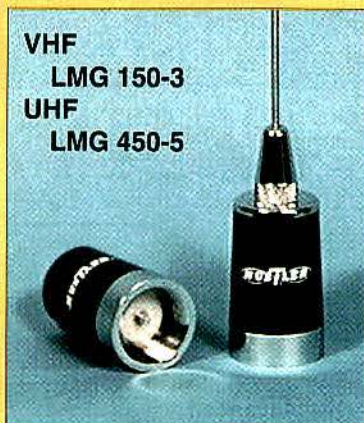
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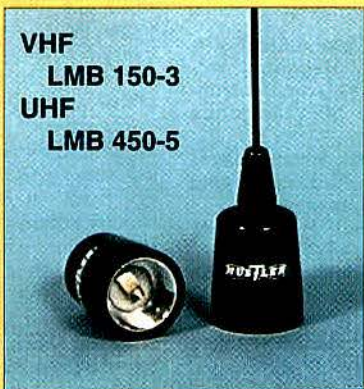
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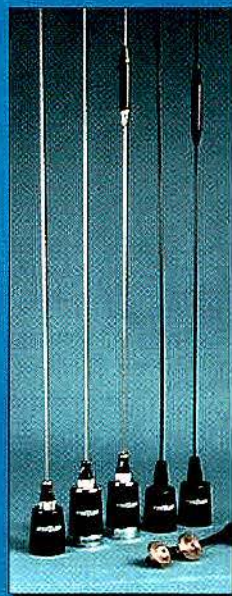
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# The lives and times of MRT



## Best wishes from the Publisher

It hardly seems possible that *MRT* is 15 years old. It seems like only yesterday that we were celebrating the unprecedented success of our first year of publication.

The industry spoke loud and clear, and we listened. You told us that the single most important factor missing in the editorial pages of the industry publications was complete, competent coverage of technology. Since our premiere issue in January 1983, we have made it our mission to provide you with coverage of the most current mobile communications technologies and products.

Over 30,000 of you have told us year after year that we are meeting your needs. You tell us by renewing your subscriptions each year. You tell us in your letters to the editor complimenting us or taking us to task. You tell us with your advertising support and with your editorial contributions. For this we thank you sincerely and vow to continue to serve the mobile communications industry with the same quality editorial that you have come to know and expect from *MRT*.

I invite you to share your comments and suggestions with us. You can email me directly at [mercy\\_contreras@intertec.com](mailto:mercy_contreras@intertec.com). I look forward to hearing from you!

—Mercy Contreras

In celebration of *Mobile Radio Technology's* 15 years as land mobile radio's premier technical publication, come take a stroll back through the history of the magazine and the industry it serves.

For a decade and a half, *MRT* has been at the technological forefront of two-way radio communications. It has been your "channel" to the FCC. It has presented cutting-edge design. It has kept you up-to-date on the political scene. In addition, it has been the harbinger of change and progress.

Back now, to the Beginning of

An irreverent glance back over the shoulder by Contributing Editor Ernest Worthman

Time (or at least of *MRT*) as we fondly remember significant people, issues and technology in our industry.

## 1983

□ Premiere issue, January/February. Phil Cook (Phil is now sales manager for our sister publication *RF Design*) is our first publisher at Weisner Publishing.

□ In one of several changes for E.F. Johnson over the next 15 years, it merges with Western Union.

□ Kenwood announces that it is entering the land mobile market. □ Mass marketing of a fully programmable, off-the-shelf mobile radio is forecast, based on the new E2PROM technology.

□ Novatel comes into existence through a joint venture by Nova of Calgary, and Alberta Government Telephone, of Edmonton. James L. Green is appointed as the first president.

□ Shirley Bonifasi is elected president of NMRA.

□ Radio Club of America celebrates its 75th birthday.

□ Jack Daniel heads the newly created Decibel western regional office.

□ Hertz is the first rental car

company to install cellular phones in rental cars.

□ Motorola supplies two-way communications equipment for the 1984 Olympic winter games in Sarajevo, Yugoslavia.

□ Mal Gurion is named president of OKI Advanced Communications.

## 1984

□ Regency Communications, a subsidiary of Regency Electronics, and Wilson Electronics merge to form Regency Land Mobile.

□ SIRSA turns 30 and elects Rocco A. Eramo as chairman.

□ Phil Cook, *MRT's* publisher, leaves to move to sunny, southern California.

Mercy Contreras soon takes over as publisher of *MRT*.

□ Robert Foosner is chief of the FCC's Private Radio Bureau.

□ Motorola puts the first Dynatac non-wireline, cellular radio-telephone system in operation in the Washington/Baltimore area.

□ Vestra acquires 2-Tel Interconnect Systems.

□ Antenna Specialists acquires Sheatron and moves operations to Cleveland.

□ Ten duplex channel pairs in the 46MHz-49MHz frequency band are allocated for cordless telephones as an amendment to Part 15 of the FCC rules (and 15 years later, the technology still sucks).

□ Robert E. "Bob" Tall leaves Industrial Communications and becomes executive director of APCO.

□ King Radio, a traditional aircraft communications manufacturer, enters the two-way radio market.

□ NABER initiates a technician certification program.

□ California puts its first cellular telephone system on-line, in Los Angeles.

□ Nynex introduces "Priority-one" cellular mobile service in Buffalo, NY. Phones cost about

\$2,500 and rates run from 20 cents to 35 cents per minute, with access fee ranging to \$49 per month.

□ Astronet is formed by Mitsubishi and Stromberg-Carlson to manufacture cellular telephone systems.

□ Philadelphia/Delaware cellular service comes on line.

□ Tandy makes its debut in the cellular product market.

□ The rules that govern FCC technician licenses expire. They are replaced by industry association and private educational institution certificates.

□ The Cellular Communications Industry Association (CCIA) forms.

□ General Signal acquires Sideband Technology.

□ NABER conducts its first series of technician certification exams.

□ Industry veteran Fred Link celebrates his 80th birthday.

## 1985

□ King Radio is acquired by Allied's Bendix Aerospace Sector.

□ Communications Specialists of California installs its first fax machine (Hey—it was big news then!)

□ The FCC rules that you can't use cellular telephones while airborne.

□ "Technical Tips," a monthly column designed to address wireless product technical problems, debuts in the February issue of *MRT*.

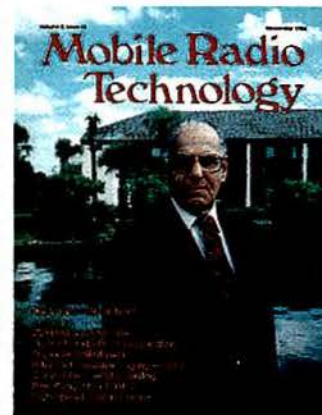
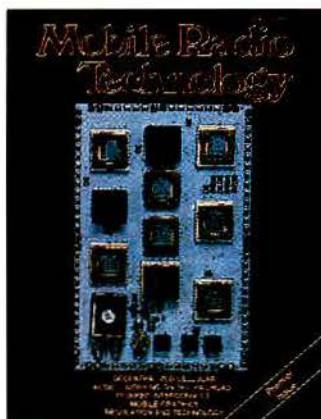
□ E.F. Johnson is for sale—again.

□ Two cellular trade associations, CCIA and the Cellular Radio Communications Association (CRCA) merge. CCIA is the

surviving designation.

□ Kustom Electronics is 20 years old.

□ The Salt Lake City area comes





on line with its cellular service.  
 □ Modifications are made to the FCC rules Parts 22, 73, 81 and 90 to reflect uniform HAAT guidelines.

□ The FCC authorizes narrow-band modes in the VHF band from 150MHz to 170MHz.

□ Cellular radio is promoted as the "greatest investment opportunity of the 20th century" according to **Robert Ringer**, author of *Looking Out for #1 and Winning Through Intimidation*. (Was he on target, or what?)

□ Cellular telephone prices drop dramatically—to about \$1,500.

□ A battle over frequency coordination brews among **ASMR**, **NABER** and **NMRA** over specialized mobile radio (SMR).

□ The spring **Land Mobile Expo** is now too big for Denver. It moves to Las Vegas.

□ **NABER** celebrates its 20th anniversary.

□ CCIA now becomes **CTIA**.

□ **McCaw Communications** purchases **Mobilephone Services** (MSI).

□ **OKI Advanced Communications** changes its name to **OKI Telecom**.

□ The battle to be the controlling frequency advisory committee (FAC) authority continues to gain more visibility. In the fray are **ASMR**, **NABER**, **NMRA**, **IAFC**, **APCO**, **IMSA**, **AASHTO**, **FCCA** and **ASNA**. (Whew!)

□ **Mobile Data International**, the leading mobile data terminal manufacturer, whose equipment is widely deployed in law enforcement, is seeing its terminals move into public services (taxi) and the utility companies. (Could we safely say that the age of ubiquitous mobile data is here?)

□ **Celwave** buys **Antenna, Inc.**

□ Cellular pay phones show up on Seattle metro buses, and San Diego taxis offer their riders cellular telephone services.

□ **Glenayre Electronics** acquires **WR Communications**.

## 1986

□ **MRT** grapples with the coming of the cellular age. A survey asks readers if they would like more, or less, coverage of the cellular industry. Result: a 50/50 split. (The times, they are a changin'.)

□ **Motorola** is named the "best managed company in America" by *New Management Magazine*. (My, times have changed!)

□ **Motorola's** anti-dumping suit against Japanese manufacturers

ends. The Japanese firms are found guilty of dumping, and must have cash deposits, of a weighted average of 58%, collected by U.S. Customs.

□ The battle over wireline and non-wireline cellular systems, "who can do what," heats up. The **PacTel-CI** merger brings to light issues,

both legal and regulatory, that will be discussed for many years to come.

□ **PacTel** and **Tandy** form a pact to activate all cellular phones sold in Radio Shack stores on **PacTel's** cellular system. Radio Shack also enters into an agreement with **A Beeper** to bring pagers sold in their stores up on **A Beeper's** service.

□ Cellular service comes to Las Vegas. (So now we can call home for cash from Expo!)

□ "Technical Tips" prints a TRS-80 BASIC program to calculate ERP. (If only we knew how important computers will become.)

□ More and more **MRT** articles contain the words "digital" and "mobile data" in their titles.

□ A new cellular trade association, the **North American Mobile Association**, is formed by **Bell Atlantic Mobile Systems**, **Bell Cellular**,

**Nynex Mobile Communications**, and **Sonacor Cellular**.

□ Certification exams are offered by **NARTE** as alternatives to the defunct FCC exams.

□ Legislation is approved by **Pres. Ronald Reagan** that allows the FCC to charge processing fees. (Riots occur.)

□ **Gary Stanford** succeeds the late **Eugene Bowler** as the FCC's acting chief of the PRB's Land Mobile and Microwave division.

□ Frequency coordination rules

are just around the corner. The FCC issues a code of conduct for squabbling coordinators and to insure non-discriminatory treatment of all applicants.

□ Somewhere along the line, **E.F. Johnson** becomes a subsidiary of **Diversified Energies**.

□ **Cincinnati Bell** acquires **Cellular Business Systems**.

□ Cellular service shows up on the New York-to-Washington Metroliner. The first three minutes costs \$5 with \$1 for each additional minute—the system accepts major credit cards.

□ Voice mail shows up on radio paging and mobile telephone services from **McCaw Telepage**.

□ **Robert Galvin** resigns as CEO of **Motorola**.

□ **Telocator** finally votes to admit wireline memberships.

□ **Nynex** acquires **Page Boy**.

□ **Robert Foosner**, FCC Private Radio Bureau chief, leaves for private law practice. Deputy Chief **Mike Fitch** assumes the helm.

□ The FCC allocates 27MHz of L-band spectrum to MSS (mobile satellite service).

□ **Intertec Publishing** buys **MRT**, and folds **Land Mobile Product News** into it.

□ **Don Bishop** becomes editorial director of **MRT**.

## 1987

□ **Encryption** is the hot topic of the day.

□ The **PacTel** purchase of **CI** finally goes through.

□ The **Telecommunications Privacy Act** goes into effect.

□ The first data radio network, based on **Motorola's** commercial data networking service, opens in Chicago.

□ The **Fred M. Link** award is

established by the RCA, and the first award is presented to—who else—**Fred M. Link**!

□ Retail cellular phone centers start popping up.

□ **FCC auctions** elicit emotional and heated debates. Nevertheless, Congress drools at an estimated \$600 million in revenue for 1988. (Was there ever any doubt that they would not be implemented? Riots occur—again.)

□ **Telocator** secures its first wireline carrier, **Bell Atlantic Network Services**.

□ **Mark Fowler** resigns as the FCC's top dog, leaving a "deregulation" legacy.

□ Rumblings arise that

**Telocator** and **CTIA** are discussing a possible merger.

□ A cellular system coming on line is no longer national news.

□ **Dennis Patrick** becomes the FCC's interim Chairman.

□ Vehicle tracking technology starts to pique the interests of major wireless players.

□ Paging subscribers hit the

6.5 million mark.

□ **Hertz** car rental starts to offer cellular phone rentals to go with their cars.

□ **Nokia-Mobira** purchases **Cue Paging** and changes its name to **DiversiCom**.

## 1988

□ We start to hear the rumblings of the "demise" of two-way as cellular becomes more ubiquitous. (An argument that will continue for years.)

□ **Maxon Electronics** spins off **Maxon Paging Products**.

□ **Alliance Telecom** of Dallas merges with **Decibel Products**.

□ **Bradley Holmes** is still waiting to become the permanent FCC chairman after **Fowler's** resignation last year.

□ **William Hotes** is elected to the post of president for **Telocator** and **Jai Bhagat** is elected chairman.

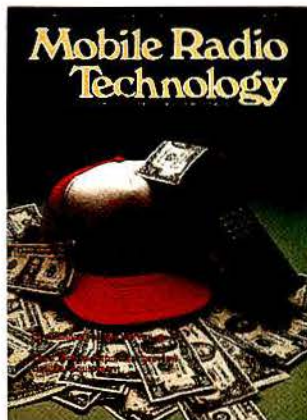
□ Technology marches on—fax units for mobile radios are being developed by **Midland** and **Medbar Industries**.

□ **U.S. West Paging** buys **A Beeper**.

□ **Novatel** wins the Canada Award for Business Excellence.

□ More and more noise is being made for trunking below 800MHz.

□ The FCC adopts a national plan for public safety that, finally, decides what to do with the





6MHz of spectrum in the 800MHz band.

□ **Susan Wing** is nominated as an FCC commissioner. She replaces **Mimi Weyforth**.

□ **Russell K. Fox** becomes **ASMR's** CEO.

□ Temporary licensing for new specialized industrial radio band customers is proposed by **SIRSA**. This is to eliminate the 30-day plus waiting period, currently the norm. **NABER** jumps on the bandwagon too.

□ **N.V. Phillips** becomes yet another player in the paging industry.

□ The **FCC** considers loosening technical and service restrictions for cellular service. Private radio rushes to protect its interests—going so far as

to imply that the FCC is attempting to rewrite the Communications Act. (*A harbinger of things to come.*)

□ **Digital Cellular** is being tested and demonstrated. **AT&T** and **International Mobile**

**Machines (IMM)** both show their stuff. Astute players see this as the ultimate cellular solution.

□ **BellSouth** buys **MCCA**, making BellSouth the second largest U.S. paging company behind **Southwestern Bell**.

□ A **Frost & Sullivan** report indicates that 900MHz will show the greatest growth in the mobile two-way market. They predict almost 8.5 million users by the end of 1992.

□ **Selectone** acquires **Airwave**.

□ It finally happens—**Motorola** makes a bid for **MDI**. (*Is there any doubt, anymore, that mobile data is here to stay?*)

□ A respondent's comment from the 1988 salary survey may speak for much of the two-way industry. Quote: "The two governing bodies, **NABER** and the **FCC**, do not know which way is up. The FCC doesn't do much anymore, and **NABER** does whatever it wants, right or wrong. I believe coordination is a thing of the past."

□ Spectrum licensing fees rear their ugly heads.

□ **Glenayre Electronics** acquires a majority stock position in **Kustom Electronics**.

□ **Motorola's** Radius line explodes. The age of low-cost off-of-the-shelf mobile radios is upon us.

□ **Centel** acquires **United TeleSpectrum**.

□ Public safety *still* can't get together on a trunking standard.

□ **TIA** is formed.

□ The **FCC** votes to permit cellular licensees to offer advanced services—including paging on cellular frequencies. Is the end of paging in sight?

□ **GE** and **E.F. Johnson** join **ASMR**.

## 1989

□ Mobile data is everywhere, and **AVL** is gathering steam as the year opens.

□ **Telocator** opens membership to private mobile communications carriers, later, its members vote it down.

□ **Celwave RF** acquires **Bogner Broadcast Equipment**.

□ The battle over trunking standards continues.

□ Fiber-optic technology arrives on the scene in earnest.

□ **Ronald Reagan** presents the first **Malcolm Baldrige** award to **Motorola**.

□ Digital cellular is accepted for the next generation of phones.

□ 800MHz trunking is killed by the **FCC**. (*Round two is next.*)

□ **ACT** struggles with a membership drive. Its goal is 500; over four months it gets 53.

□ **Regency Electronics** changes its name to **ReIm Communications** and purchases **Land Mobile Communications Group** from **MA/COM**.

□ Politicians play their immature, silly games with the **FCC**. Congress and the **FCC** are at odds, only three commissioners are seated—and there are threats of *them* leaving. Foot dragging by Congress cause nail-biting in the wireless community.

□ **Sony** enters the mobile communications market with two-way, satellite-based, mobile communications units. Satellites play an ever-expanding role in terrestrial-based

1989—  
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mobile communications.

□ The **FCC** proposes allowing third party service providers to supply public safety communications services. *Everyone* thinks it's a bad idea.

□ The **American Private Radio Association (APRA)** is formed.

□ The battle over sharing UHF spectrum with land mobile users *really* heats up.

□ The **FCC** finally moves to break the frequency coordination monopoly with Docket 88-548. It will allow applicants to submit Form 574 directly to the commission. *(There is dancing in the streets!)*

□ Congress buckles under pressure and seats three new commissioners by the end of the year. They are: **Sherri Patrice Marshall, Andrew Camp Barrett** and **Alfred C. Sikes**. The Commis-

sion is whole again.

## 1990

□ The battle over direct access for license application continues—and debate heats up.

□ Nationwide and international paging are the next hot paging technologies. The industry worries about a shortage of frequencies, according to **Telocator**.

□ Cellular puts pressure on frequencies. **SMR** worries about losing spectrum.

□ **Mercy Contreras, MRT** publisher under Weisner, becomes publisher for **Intertec**.

□ Cellular subscribers are nearly 2 million strong!

□ Unlicensed users become a major issue for the **FCC**.

□ An unorthodox **FCC** frequency allocation grant to the **Southern**

**California RTD** presents the worst scenario for uncoordinated frequency assignments, further muddying the waters over direct access and assigned frequency coordination requirements. *Everyone's* filing comments.

□ **IBM** and **Motorola** partner to

create the **Advanced Radio Data Information Service (ARDIS)**. *(The big boys throw their weight behind mobile data. Skeptics are silenced forever.)*

□ **E.F. Johnson** acquires a majority interest in **Americom**.

□ **McCaw Cellular** acquires **Lin Broadcasting's** cellular holdings.

□ **Ericsson**

**Mobile Data** is established to support the **Mobitex** public mobile data network operated by **RAM Mobile Data**.

□ **UHF/Two-way** sharing loses priority to new **HDTV** technology.

□ Cellular phones drop to less than \$500 and carrier "incentives" to resellers are used to lower prices even more.

□ Conditional licensing gets the go-ahead.

□ **Thomas A. Stroup** takes over the reigns of **Telocator**.

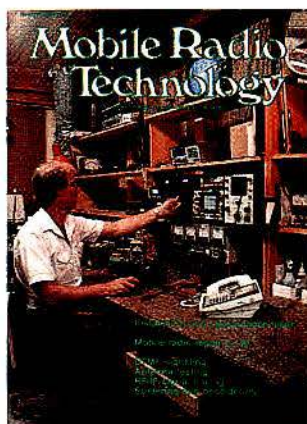
□ **Ervin S. Duggan** is confirmed as the latest **FCC** commissioner.

□ **FleetCall** gives a wake-up call to the industry when it asks the **FCC** to allow it to use digital modulation, **TDMA**, and frequency reuse on its **SMR** systems—all against current **FCC** rules. The future of **SMR** is here—now!

□ The "**Dingell**

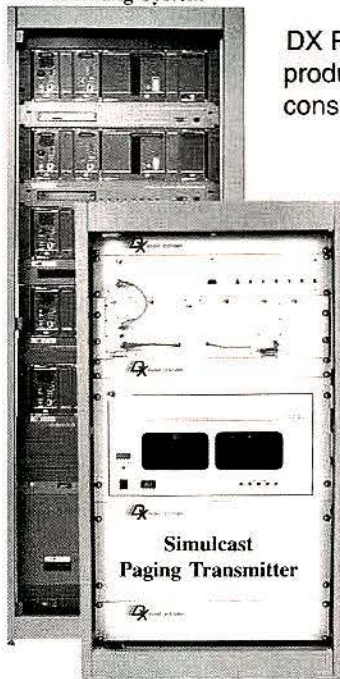
**Bill**," which would relocate up to 200MHz of spectrum from the federal government to the private sector, has the private wireless industry drooling.

□ **AVL** pops up *everywhere*.



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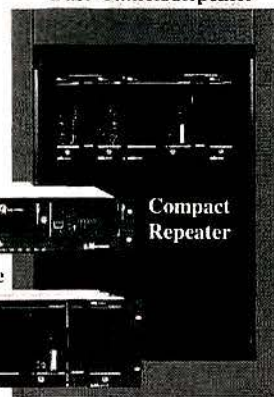
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□ Millidyne acquires Sequel Data Communications. Controversy still haunts this issue.

□ Sears enters the cellular telephone market with phones and accessories—charge it!

□ Experimental PCN systems are popping up all over.

## 1991

□ The FCC's Inspector General undertakes a survey audit of frequency coordinators for PLMR.

**1990—Enhanced specialized mobile radio (ESMR)—low power and digital technology—makes its debut.**

□ Motorola's NAMPS comes on the scene to address the issue of potentially crowded cellular frequencies.

□ Computer technology starts showing up in all phases of wireless technology: billing; diagnostics; service shop operations; and paging, as well as component hardware.

□ The UHF-land mobile frequency sharing debate goes on. AMST asks

the FCC to review the licensing procedure after another case of rules violations in Indiana.

□ Edgar F. Johnson, E.F. Johnson's founder, dies at age 96.

□ "Wristwatch pagers" are touted as the next generation of pagers.

□ Most of FleetCall's waiver is denied by the FCC. It claims that what FleetCall wants to do can be done under the present rules. The SMR industry celebrates; the cellular industry cries foul.

□ LM Ericsson buys SCE.

□ Comcast moves to establish an experimental PCS system that links cellular, cable TV and PCS.

□ SprintNet links up with ARDIS.

□ Alan Shark takes over the reins of ASNA as its president.

□ PCS prognosticators expect it to be a \$55 billion business by the year 2000, with phones costing less than \$250 and service costing about \$40 per month. (We'll see.)

□ Ian Wright, chairman of ACT's volunteer leadership council, steps down. He has had the reins since its inception in 1986.

□ The FCC denies ASNA's request to reallocate 2MHz of 900MHz spectrum to PLMR.

□ The paging industry is now over 10 million subscribers strong.

□ ASMR changes its name to AMTA.

□ Guess what? Telo-cator now proposes to call itself the Personal Communications Industry Association (PCIA).

□ ACT membership drops by nearly 300, as it struggles to remain the representative organization for communications technicians.

□ APCO reveals Project 25, for the next generation of digital radio.

**1991 — Computer-aided dispatch (CAD) is being rolled out in public safety, paging and other wireless applications.**

## 1992

□ FleetCall's ambitious project to roll out ESMR starts to unravel. (Long-time SMR operators find it a bit too ambitious.)

□ In-building communications systems, an offshoot of the PCS technology, are expected to be \$2.1 billion market by 1997.

□ 200MHz reallocation rears its ugly head again as bills are again reintroduced in both the House and the Senate.

□ FleetCall is still threatening to build ESMR.

□ Technology is taking its toll on equipment. Serviceability is the number-one issue for technicians on new equipment. They cite surface-mount technology; large-scale integrated devices and embedded components as the culprits.

□ For the first time, the SMR industry growth rate is slowing, adding fuel to the argument that SMR has a limited future.

□ The UHF channels 14 and 69 and LMR interference issue is addressed by FCC MM Docket No. 87-465. No one is happy, and Motorola immediately files a petition for reconsideration.

□ Allen Group buys Alliance Telecommunications, parent organization of three major



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industry players: **Decibel products, Comsearch,** and **db Mobile.**

- **Reim and Adage** merge.
- GPS-based AVL, married to digital mobile data terminals, forms the footprint for accurate, affordable AVL. *(Finally!)*
- The number of paging users hits 12 million.
- Cellular data rates achieve 19,200bps, and "packet" radio comes on line.
- **ERMES** is considered as a next-

**1992—The FCC moves to "reform" PLMR spectrum below 470MHz.**

generation paging code.

- There are now more than 8.5 million cellular subscribers in the United States.
- First rumblings about digital cellular phones are heard.
- **ACT** finally offers multiple testing sites, continuous testing and immediate results.
- **SIRSA** changes its name to **Industrial Telecommunications Association (ITA).** *(One needs a scorecard just to keep up with the players.)*

□ **SMR** operators breathe a sigh of relief because they no longer have to license end-users. *(Whew!)*

## 1993

□ 220MHz lies silent, waiting for private radio users. *(Hmmm.)*

□ **ESMR** (now **digital SMR**) is still controversial, especially the effect short-spacing will have on signal overlap. **ESMR** is touted as offering a challenge to cellular.

□ **FleetCall** and **DisCom** merge **SMR** operations.

□ Projected growth in analog **SMR** is predicted to stay level, while digital **SMR** is predicted to increase significantly. By 1995, the industry will be adding more digital units per year than analog units according to **EMCI**, a Washington DC-based consulting firm.

□ **Telocator** predicts 23 million **PCS** subscribers by 1997. *(Hmmm ... again.)*

□ **Emergency Medical Radio Service (EMRS)** is approved by the FCC.

□ Consumers worry that the 900MHz frequencies that cellular phones radiate a few inches from our heads will cook our brains. *(Yeah, right, like 60Hz power lines have, for years, been blamed for everything from hemorrhoids to schizophrenia.)*

□ **Pagers** are ubiquitous in retail and discount stores. **MobileComm** and **McCaw** see a gold mine and join forces to cover major metropolitan areas.

□ The first high-accuracy GPS is deployed in Los Angeles. **Pinpoint**, a joint venture by **Magnavox** and **CUE Network**, provides accuracy to within a few feet using both satellite navigation and local FM stations.

□ **E.F. Johnson** celebrates 70 years in the industry.

□ **FleetCall** changes its name to **Nextel Communications.**

□ **Robert H. Schwaninger Jr.** joins **MRT** as its regulatory consultant and columnist. *(Riots occur—at the FCC.)*

□ **Mtel** receives the first final **Pioneers Preference** for a **PCS** system in the U.S.

□ The first commercial 220MHz trunking system is activated in Houston.

□ If you don't use the word "wireless" at cocktail receptions, in business jargon and in everyday conversation, you're not hip. *(It's a wireless radio—as opposed to the previous kind.)*

**1993—Digitally controlled consoles find their way into SMR base stations.**

□ Congress finally passes legislation to eliminate lotteries and let the FCC auction spectrum instead. *(It's hoped that this will take the dentists, accountants and Harvard MBAs cartels out of the two-way radio business—but will it?)*

□ **SCL** purchases **Midland International.**

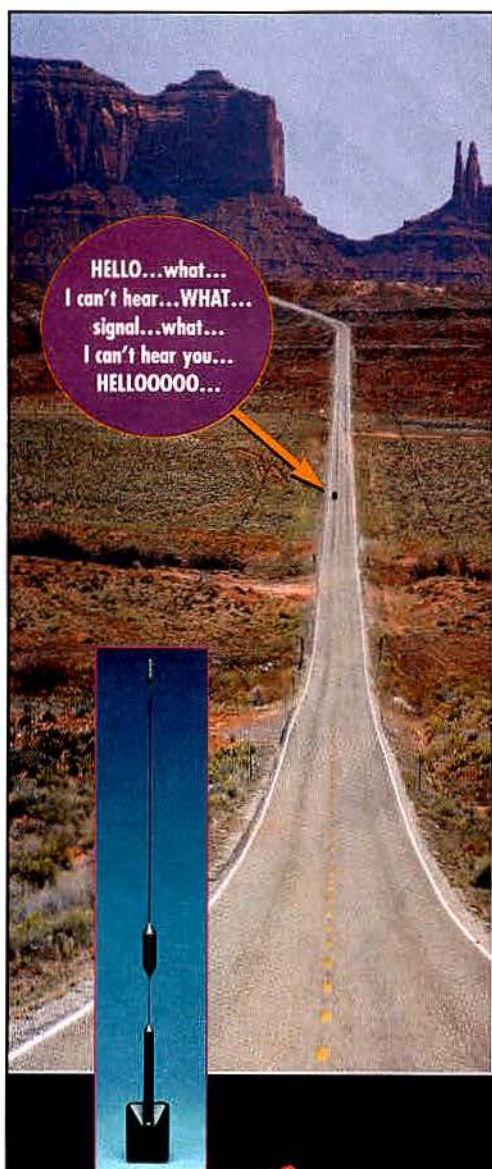
## 1994

□ The **FCC** collects user and filing fees.

□ **ITA** asks the **FCC** to institute a program to certify technicians. *(Why?)*

□ **CenCall** starts buying **Motorola** 800MHz **SMR** properties.

□ **U.S. West** sells its paging operation.



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## Interconnects

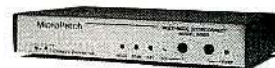
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**9800** Provides selectable interconnect mode; Control Station, Half Duplex or Sampling. Has built-in Repeater maker; DTMF, CTCSS, 2 Tone, and 5/6 Tone signalling; Speed dialer and more.

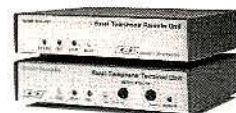


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□ During the next 10 years, **intelligent vehicle highway systems (IVHS)** will become one of the fastest-growing and most lucrative areas of the telecommunications industry (*writes Robert H. Schwaninger Jr.*).

□ **Telocator** is now **officially PCIA**.

□ **MCI** buys a 20% stake in **Nextel**.

□ Industry pundits predict 4.4 million SMR subscribers by 1998.

□ **CDMA** (code-division multiple-access technology) is being taken seriously.

□ 220MHz narrowband SMR is finally a reality.

□ The first FCC **PCS license auction** nets \$6.17 billion (*on paper*).

□ **PCIA** and **NABER** merge; new life is breathed into PCIA.

□ Frequency coordination is again under scrutiny.

□ **Dial Page** and **Nextel** marry; **Nextel**, **Comcast** and **MCI** divorce.

□ 800MHz generates more excitement as the FCC freezes new licenses and rumors of dismissal of pending licenses abound.

□ **SMR WON** is formed.

□ The U.S. Court of Appeals strikes down the FCC fines and assessments policy. (*There is dancing in the streets, again.*)

## 1995

*It's a year of partnerships, alliances, mergers and agreements. Watch closely.*

□ The FCC has more than its share of problems: lawsuits; influence peddling; claims of favoritism and "donation" acceptance all

seem to tarnish the Commission's image.

□ The FCC lifts the ban that prevents traditional telephone companies from holding SMR system licenses. Hardly anyone notices.

□ PCS still isn't here.

□ ESMR still isn't here.

□ **Reed Hundt** is in charge of the FCC.

□ **MCI**, **PageNet**, and **SkyTel** enter into agreements to provide nationwide, wireless messaging to MCI customers.

□ **Glenayre** and **Western Multiplex** merge.

□ **Racotek** and **Ericsson** enter into an agreement to implement wireless data and voice on the Ericsson EDACS network.

□ **Glenayre** and **MobileComm** form a partnership to develop a two-way wireless messaging service.

□ **Geotek** and **Hughes Network**

**Systems** ally to develop products for frequency-hopping multiple-access (FHMA) systems.

□ **Ericsson** and **Uniden** forge a cross-licensing agreement.

□ 800MHz is *still* waiting for the rulemaking.

## 1996

□ Pressure mounts to reduce the 20-odd radio services to four—or three—or two. (*Wonder why.*)

□ **MTA-EMCI** projects over 60 million U.S. cellular subscribers and 20 million PCS subscribers by the year 2000. (*And guess what? Most of them will be consumers!*)

□ Digital cellular. (*Where? How? What happened?*)

□ **Intertec Publishing** buys **Argus Inc.**'s assets, picking up 36 magazines,



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The advertisement features a large black background. At the top, the word "BULLSEYE" is written in large, red, bold, sans-serif capital letters, arched over a graphic of three concentric white circles. The innermost circle is centered on a photograph of the Zetron Series 4000 Communications Control System. The system consists of three dark grey metal cabinets. The left cabinet has a control panel with many buttons. The middle cabinet has a computer monitor displaying a blue screen with text and a keyboard. The right cabinet has another control panel with buttons and a small display. The text "Zetron's Series 4000 Communications Control System" is printed in black on a yellow triangle at the bottom of the concentric circles.

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including **RFDesign** and **Satellite Communications**, and trade shows including the **International Wireless Communications Exposition (IWCE)**. **Communications** magazine, included in the purchase, is terminated, and its coverage is incorporated into **MRT**.

□ Paging sees new technologies take on the status quo. **ERMES** and **Motorola's Flex** step up to the plate.

□ **Small Business in Telecommunications (SBT)** is formed, with **Lonnie Danchik** as first chairman.

□ **David Packard**, co-founder of **Hewlett-Packard**, dies at age 83.

□ **IWCE** celebrates its 20th anniversary.

□ The FCC "downsizes." (This should be interesting.)

□ Paging sees a new technology emerge. **PACT** (personal Air Communications Tech-

nology) promises two-way messaging and a messaging protocol. (We'll see.)

□ **MTA-EMCI** is at it again. It prognosticates that there will be more than 60 million pagers in service by the year 2000.

□ **Midland** is sold again — this time to **Intek Diversified**.

## 1997

□ **Telematics** (?) hit the market to offer combined cellular, GPS, status messaging and voice communications for the automobile industry. (See "2005," below.)

□ The first totally IS-136 digital cellular system that uses SMR frequencies is on line.

□ **Securicor** controls **Intek**.

□ New licensing rules for the remainder of the 220MHz–222MHz spectrum are released by the FCC.

□ Voice messages come to pagers.

□ **Nextel** has lost almost \$900 million over the last two years.

□ **Trident Micro Systems** forms "technology alliances" with multiple manufacturers for trunking technology.

□ **Reed Hundt** leaves the FCC—eventually.

□ Here we go again: **ACT** changes its name to **AWCET**. **AWSI** and **SMRA** merge to form **MWCCA**. (Whew! Good thing I can spell.)

□ The FCC threatens to auction 800MHz again—maybe.

## 1998

□ **220MHz auctions** are here again (to the tune of "Happy days are...").

□ **William Kennard** becomes FCC Chairman. Four other commissioners join him: **Harold Furchgott-Roth**, **Susan Ness**, **Michael Powell** and **Gloria Tristani**.

□ **Nextel** bids over \$88 million in the 800MHz auction, winning 90% of the licenses. (Boy, sure hope they know what they're doing—see "2005.")

□ **Transcrypt International** buys **E.F. Johnson**. (This is probably the end of Johnson, as we know it. Oh well. But things look good for Transcrypt.)

□ **PCS** is finally a reality. (Funny ... it looks just like a cellular telephone.)

□ **PCS** still hasn't replaced paging.

□ Cellular telephones are free.

**1998—Dynamic channel multi-carrier architecture (DCMA)** aims to put five FM channels on a current single channel allocation.

## 2005?

□ **PCS** is everywhere and the cellular industry is defunct. Paging? What's paging?

□ "It's digital" doesn't mean "it works."

□ **Nextel** is the only SMR provider left on the planet—but they're being bailed out by the government. (Remember Chrysler?)

□ The FCC disbands, and **PCIA** is in charge of licensing, auctions and frequency coordination. Jay Kitchen signs autographs.

□ **PCIA**, **ITA**, **AMTA**, **SBT**, **APCO**, **ASMR**, et al, all get together to form **MESS**.

□ **Schwaninger** is still writing for **MRT**?

—Ernest Worthman, circa 1998



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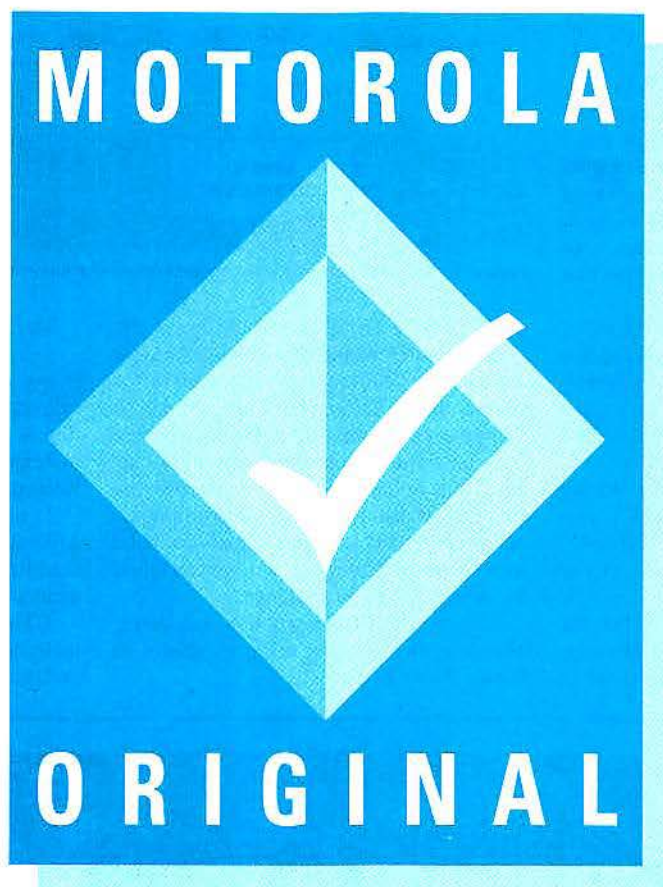
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## Technically speaking

(continued from page 8)

between the spectrum analyzer input and the sniffer probe as shown in Figure 1 on page 8. The sniffer probe is made by winding several turns of enameled wire into a self-supporting coil and attaching it to an SO239 connector as shown in Figure 2 on page 8. The preamplifier was a Radio Shack model used for CATV—not exactly a low-noise amplifier—but considering the noise figure of a spectrum analyzer, the amplifier was of sufficient quality for such work. With about 20dB of gain, the amplifier would allow us to see signals on the spectrum analyzer that normally would not be seen.

Using this test arrangement, a couple of mechanics, our communications technician and I set out to find the source of interference. First, the ECU that controls the engine was checked and found to be clean. At that point we did not realize that there was *another* ECU on board. Eventually, during the searching process, the second ECU was discovered behind the seat. That ECU controlled the automatic transmission for the vehicle.

In the interim, we had discovered that the truck did not have to be running to cause interference. With the radio receiver set to

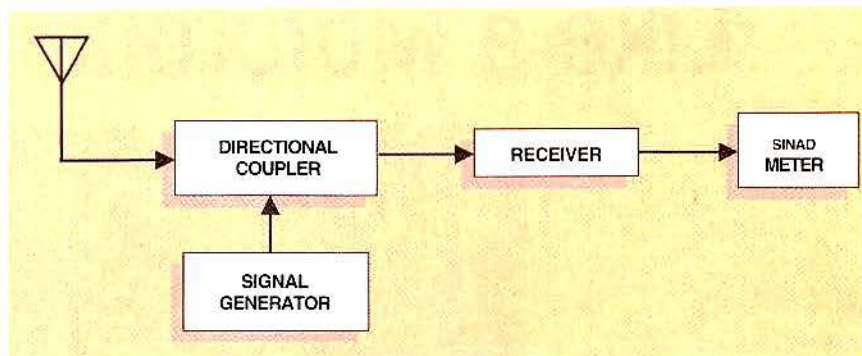


Figure 3. This test setup is used to determine the severity of the interference.

receive at 159.270MHz, just turning on the ignition switch would cause an intermittent carrier to be heard in the radio receiver. Of course, the CTCSS squelch system had to be bypassed by removing the microphone from the hook or pressing the monitor button. While holding the sniffer probe near the automatic transmission ECU, and turning on the switch, many spurious signals could be seen on the spectrum analyzer. We had found the source of the interference.

The severity of the problem was determined by using a test setup as shown in Figure 3 above.

The test procedure is:

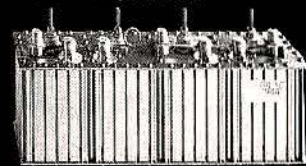
- 1) Set the signal generator to the receiver frequency, and with the truck switch turned off, set the signal generator to 3kHz deviation at 1kHz and adjust the generator level to produce 12dB SINAD on the SINAD meter. Record the signal generator level in dBm.
- 2) Start the engine. Increase the signal generator level to return the SINAD meter reading to 12dB. Record the new signal generator level.
- 3) The difference between the signal generator level in steps 1 and 2 is equal to the amount of degradation caused by the interference.

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In this particular case, the interference was causing 19dB to 20dB of degradation. This level of interference could not be tolerated by our radio system, so some remedy had to be found.

Because this automatic transmission was an Allison World Transmission model, we decided to contact Allison for assistance in solving the problem. After several communications back and forth, it was decided to try a couple of different ECUs in the truck to see if any improvement resulted. This was done by Allison at one of their local service facilities. We were requested to run our test to see what, if any, improvement resulted from the different ECUs being installed.

The two ECUs were set at different operating frequencies. One was at 7.996MHz and the other was at 8.004MHz. The Allison service representative installed first one, then the other, ECU as we tested for results using the previously described test procedure. Tests were run at 159.270MHz, 154.130MHz and 151.400MHz. The interference at 159.270MHz was always the most severe, even with the newer ECUs. However, the amount of degradation dropped from 19dB-20dB to about 6dB. Although this was still undesirable, it represented progress. Maybe 2dB to 3dB would be tolerable, but not 6dB.

The service representatives at the Allison service center are currently working with the manufacturer of the ECU to reduce the interference to a tolerable level. The work is still ongoing, and the ultimate solution is yet to be found. I will pass along information on the final solution when it is reached. A newer International truck, with a similar transmission and an ECU made by the same manufacturer, was tested and found to produce only minimal interference.

Problems such as these require the manufacturer's cooperation to arrive at an effective solution. Without such cooperation, the probability of a successful outcome would be low. Even with full and unswerving cooperation, the solution is not easy.

Because of more and more EMC problems, I have advised our fleet manager to put something in the specifications to include the effects of electromagnetic interference (EMI) to our radio system (and from our system). Because more electronic devices are being added to vehicles, the problem is sure to get even worse in the future. The EMC problem is best handled at *design time*, rather than trying to find solutions after units are manufactured and sold to unsuspecting users. When buying such equipment, be aware of such problems and if possible, test one of your system radios in an actual vehicle under typical operating conditions before purchasing the vehicle.

A complaint from one of our county rangers was: "My windshield wipers start up when I key the transmitter on one of the repeater channels." In order to get to the electronics that controls the wipers, I removed a portion of the dash panel. As I was preparing to set that portion of the dash panel aside, I noticed that the mini-UHF coax connector on the radio was hanging by the center pin. The shield of the plug was not even making contact with the radio connector. Yet, the radio had been working well enough that the user had no complaint about the radio operation.

Because the shield was not connected, I immediately thought this might be the problem causing the wipers to start up when the radio transmitter was keyed. To check, I simply connected the coax connector firmly to the radio and tested for the result. Bingo—that was it. Such a simple solution for such a seemingly complex problem. I had seen this type of connector get loose before and cause other symptoms such as a loud buzz in the broadcast radio in the vehicle. This is the type of thing that should be checked first.

Until next time—*stay tuned!*



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## Toward gentility

By Robert H. Schwaninger Jr.

My wife, Isabel, is a wonderful woman to put up with a lout like me. It seems I don't understand the need for paté, when liverwurst sells for \$3-a-pound less. She gravitates toward Piñot Noir and Cabernet, selected for vintage and chateau. I reach for a Bud, flipping the cap across the kitchen counter, rather than sniffing some musty cork.

With a sigh, she sends me back upstairs to find a tie that doesn't clash with a shirt or a coat or some other piece of insignificant clothing. Her threats to use Garanimals tags to get me dressed often sound quite serious. I forget to shine shoes, pick up laundry, shave and, occasionally, bathe. But somehow she prods and bullies me into some semblance of civility.

Then there's my choice of language. It's ... well ... colorful. Some might say "salty." She would simply explain that for a relatively educated man, my choice of words and jokes pushes the envelope of propriety. Privately, she tells me that I'm a foul-mouthed man with a penchant for inappropriate humor. Isabel confesses that she simply cannot understand how anyone with my erudition and writing skills can fall into a smut rut.

I stand accused, and I am guilty. I've never

Schwaninger, *MRT's* regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.



**"YES, I KNOW YOU HAVE A PINK SLIP — BUT I'D LIKE TO LOOK AT THE TITLE!"**

ILLUSTRATION BY JOHN HAYES

obtained the flair of political correctness that allows one to excuse a boor, a liar or a cheat. When someone is being deceitful, and not merely foolish, I unashamedly tend to point out their character flaws with some precision. When the politic thing would be to ignore obvious machinations of government officials, I tend to flare up and demand an explanation. It's a curse.

My partner, the far more cerebral and genteel Mr. Curt Brown, Esq., has unfortunately been occasionally affected by my frightfully overbearing methods. Over the

years, we have stayed together, even when I'm certain that he has been embarrassed by my histrionics. If you have been blessed with an ugly baby, Brown is better equipped to deal with the unveiling.

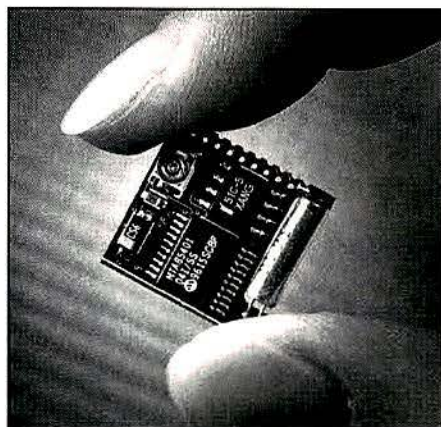
But our partnership has withstood the differences, and our styles have blended together nicely to provide a more poetic Brown and a more precise Schwaninger in an uncertain harmony of forthrightness. So when our methods and tone were recently attacked in a pleading before the FCC by none other than ("We can't take a joke") Nextel Communications, we were amused.

In its opposition to an Application for Review that we filed with the commission, in which we noted that the Wireless Telecommunications Bureau (WTB) had made a few errors in granting a handful of licenses to Nextel, resulting in Nextel's receiving at least 30,000 SMR channels based on patently defective applications, Nextel took umbrage with our "behavior" before the agency.

Drawing on excerpts from the historical record, Nextel's first admonition involved a pleading our firm prepared five years ago wherein the pleading party accused the opposing party of "whining." It's true. We did it. We wrote a petition that included that very word. Our shame cannot be greater.

Nextel also objected to our (still-pending) petition that requested that the Commission take notice of the fact that the infamous "Fleet Call Waiver" was granted in 1991, and that the five-year construction period had run out. We simply requested that the FCC audit Nextel's construction, as it does all other licensees, and take back any channels that were not constructed in a timely manner. The WTB

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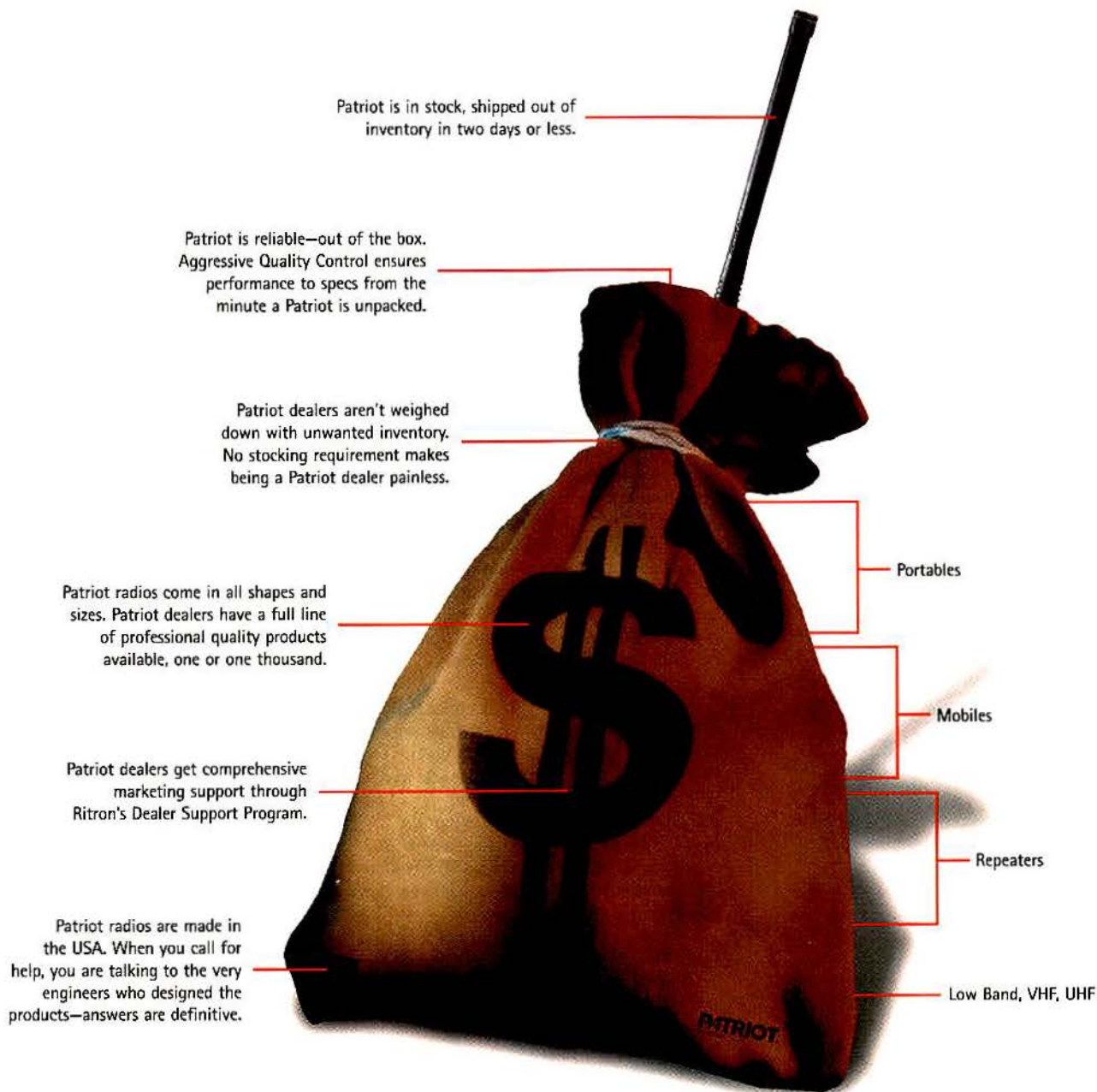
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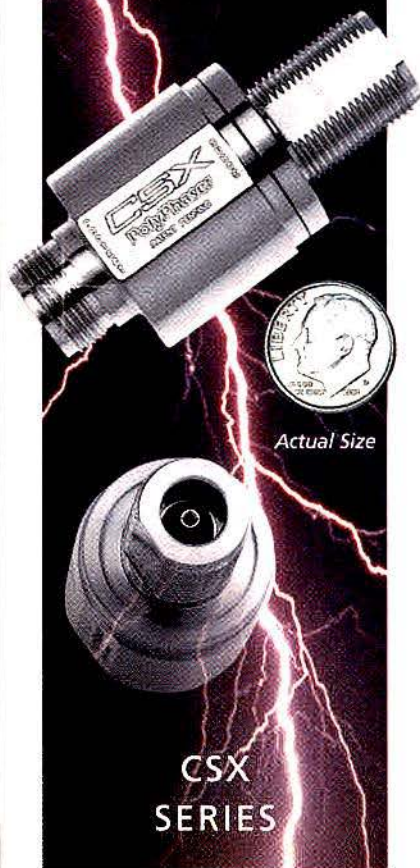
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## Regulating technology

has not yet ruled on our two-year-old petition or, to our knowledge, sent Nextel an "800A" letter. Again, we admit our audacity in employing the most devious of all devices: a calendar.

Nextel's opposition continued down this path, attempting to cobble together a case that Brown and I had somehow breached the line of propriety in our past efforts, citing events that have transpired over the past five years in which we played no small part. What Nextel was trying to prove is still a mystery to me. What Nextel did *not* prove was that all of its applications were properly granted by the commission.

In fact, Nextel did not even try.

Nextel's failure to defend the appropriateness of its licenses is quite troubling (he said, in his most polite manner). I assume that Nextel intends to engage in frequency migration of incumbent licensees to solidify its position following the 800MHz auction. But its inability or unwillingness to demonstrate clear title to many of its licensees poses a sticky problem.

If you are an incumbent licensee who has been informed that Nextel intends to migrate your system to lower channels, then the duty falls on Nextel to deliver the channels out of its warehouse to complete the task. An incumbent's first logical question then may be, "Can you kindly demonstrate clearly that the channels you are offering are *yours*?" If my experience is any indication, Nextel will be quite put off by this question.

But it is a *fair* question.

An economic area (EA) licensee is obligated to present channels to the incumbent that will not result in later legal problems for the migrated operator. Therefore, a title search is in order. Each channel offered should be scrupulously checked to assure that the EA licensee holds the license (or title) to the channel freely and without cloud. The burden for demonstrating that the goods are genuine falls squarely on the EA licensee.

To assist readers in their request for bona fides, I humbly suggest that one begin at the beginning. Each incumbent licensee should ask to see all applications, licenses, modifications, frequency coordination, co-channel facility licenses, engineering, fee records, waiver requests and associated documents that make up the record, which together demonstrate the EA licensee's title to the channel. If confirmation in the form of representations and warranties from past licensees regarding construction and operational status is required, then such documents should also be politely requested in an inoffensive manner.

To be complete in this examination, an incumbent licensee may need to review the applications and licensing of entire ESMR footprints. If the channel being offered was granted as a portion of complex ESMR sys-

tem, the entire system will require a review. This (he said, respectfully, and with great deference) is due to the manner in which many channels were granted. Grants of licenses were often interdependent with grants of other channels.

Next, the incumbent should politely request that the EA licensee demonstrate that the subject channel is capable of being moved from its presently authorized location to the new location where the incumbent's system is operating. Remember, lower channels are not as mobile as one may have been led to believe. Therefore, a complete review of co-channel facilities will have to be performed, and engineering that demonstrates compliance with the FCC rules will be required to assure that the channel is eligible for the intended use.

During this process, one should take special care not to offend the tender sensibilities of the EA licensee. All incumbents have been charged with the duty to be "reasonable" in their individual approach to frequency migration. I suggest that all correspondence should be quite cordial and professional—even fawning, if need be. Nextel is easily offended by any suggestion that any of its licenses may be more the color of money rather than the color of law.

I, therefore, respectfully offer the following example of future correspondence:

*Dear Sir or Madam:*

*We are impressed beyond belief in your company's past abilities to achieve licensing heights to which we might only aspire. It is with great humility that we must confess that we lack your laudable bravado and confidence in our limited ability to retain the channel offered for use at our location. We are but simple folks who, as you know, are subject to the FCC rules. Although we know that our requests must seem the trivial squeaking of a recalcitrant mouse, we must respectfully request that your company demonstrate its rightful title to the channels so generously offered.*

Alas, the EA's likely response will be to question your character qualifications to be a commission licensee. And if they do, dear reader, smile placidly, and warmly tell them to go to ... er, to stick it in their ear.

*Editor's note: Due to an editing error, a disclaimer relating to Robert Schwaninger's affiliations outside of his law practice and association with this magazine was printed incorrectly. He is general counsel to Small Business in Telecommunications, and he is a principal in the business operated by Jim Fryer. Both organizations are mentioned in his column in the April issue.*



## Chadmoore looks at long-term financing, increases subscriber base

Chadmoore Wireless Group, Las Vegas, has gone from "little chance of survival," despite increasing subscriber units, to realizing a potential \$10 million investment in its company.

system construction rather than marketing our service," said Jan Zwaik, Chadmoore chief operating officer. "An FCC mandate released in May of last year reduced Chadmoore's allocated build-out time from



Chadmoore Wireless Group's new headquarters in Las Vegas.

This March, Chadmoore entered into a letter of intent with Recovery Equity Partners II, San Mateo, CA, an institutional private equity fund. Recovery is to invest as much as \$10 million of equity capital into Chadmoore. Under the terms of the transaction, which remains subject to certain contingencies (including Chadmoore's securing \$10 million of debt financing), Recovery would invest \$5 million initially. Recovery will also have a warrant to purchase an additional \$5 million at a higher price. This warrant will be callable by Chadmoore under certain circumstances after April 1999. The company is pursuing \$10 million of secured debt financing in conjunction with Recovery's equity investment as well, with closing of the contemplated transactions expected to occur over the next several weeks.

"For the first time in its history, Chadmoore has the opportunity to put a long-term financing strategy into place," said Robert Moore, president of Chadmoore. "As recently as six months ago, most of the industry and the financial community gave us little chance of survival."

Chadmoore announced in February that it had surpassed 10,000 subscriber units in service on its systems.

"At this time last year, we had only a little over 2,000 units activated in four markets," Moore said.

"...Much of 1997 was focused on initial

two years to six months. By November, we had completed initial construction in 169 markets throughout the United States."

Chadmoore has also reached an agreement with GeoTrans Wireless, a turnkey provider of wireless engineering and construction services and a wholly-owned subsidiary of Tetra Tech. GeoTrans will assist Chadmoore with network engineering and wireless design to fully commercialize its Teamlink service for small- and medium-sized businesses in as many as 145 of its existing 168 markets.

Chadmoore has relocated its corporate headquarters to 2875 E. Patrick Lane, Suite G, Las Vegas, NV 89120.



Moore



Zwaik

## FCC delays May 19 220MHz service auction

The 220MHz auction, previously scheduled to begin May 19, 1998, will be delayed pending FCC resolution of petitions for reconsideration. The new auction date will not be announced until within five days after the commission rules on the petitions. The Wireless Telecommunications Bureau will release a Public Notice announcing key dates, procedures and terms for the 220MHz auction.

The auction will consist of 908 licenses in the Phase II 220MHz service with three nationwide licenses, 30 regional economic area groupings and 87 economic area licenses. The licenses consist of the following channels:

Nationwide Block	Channels
Channels 51-60	10
Channels 81-90	10
Channels 141-150	10

### EA Block

A: Channel groups 2, 13	10
B: Channel groups 3, 16	10
C: Channel groups 5, 18	10
D: Channel groups 8, 19	10
E: Channel groups 171-180	10

### 220MHz EAG Block

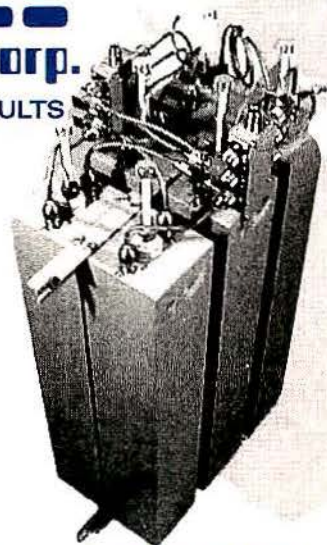
F: Channel groups 1, 6, 11	15
G: Channel groups 4, 9, 14	15
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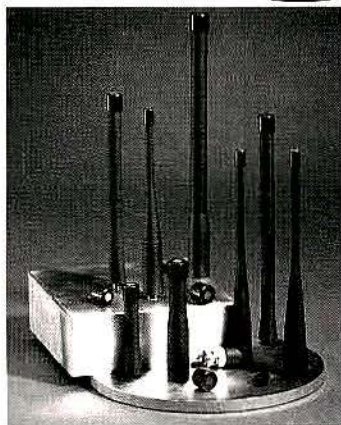
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## News

### Exports, UHF trunking boost Uniden's prospects

"Uniden wants to increase its land mobile business revenue by 20% in 1998 and another 20% in 1999," said Yasuhito Hara, vice president of sales for the Private Radio Communications Division of Uniden America, Fort Worth, TX. Asked how Uniden now ranks among two-way radio equipment manufacturers, Hara said that the company probably is in a close grouping for No. 3 with Kenwood Communications and Transcrypt International, with Motorola in the top spot and Ericsson in second. "We want to be in the top three or top two by 2000," he said.

UHF portable and mobile FM two-way radio units with LTR trunking capability are expected to account for sales increases, as are units with the 12.5kHz and 15kHz channels required under spectrum refarming.

Further sales increases are expected from the division's multisite dispatch (MSD) equipment and software. Uniden's current trunking software provides single-site and two-site dispatch capability. With the MSD enhancement, as many as 16 sites can be networked, a feature that is expected to have worldwide appeal.

Rounding out the division's strategy is continuing growth in export sales.

In addition, by the end of the year, the division might introduce channel-multiplying trunked system products, although the particular technology has yet to be chosen.

Hara's ambitious sales goals contrast with Strategis Group's estimated 5%-8% annual growth for land mobile. The growth comparison is not necessarily apples to apples because definitions of the land mobile market differ. Even so, the division will have to increase market share to achieve the desired growth.

Hara spoke at a meeting in the company's headquarters attended by division Executive Vice President Kazuo Suzuka, Marketing Manager Glenn Gordon and Marketing Assistant Michele A. Sheriff. Participating by telephone were Sal Farina, domestic sales manager; and

Jon Osler, international sales manager.

The land mobile business represents about 10% of Uniden America's sales, with most of the remainder involving consumer electronics. With this comparison in mind, Suzuka explained why Uniden continues in two-way radio. "Because there is a market demand, and it is our responsibility to support it. It is basic radio communications, different from consumer and multimedia. It is part of the identity of Uniden. We should keep two-way radio, even as everyone else concentrates on cellular and PCS," he said.

Hara explained that part of what helps his division to provide competitive, high-tech private radio products is the ability of the division's own engineers to adapt research and product development conducted by 200 engineers in the company's consumer electronics divisions in San Diego. Adapting technology developed for cellular and PCS, the private radio division can meet customer demand for miniaturization, component integration and features.

Uniden's land mobile sales grew in the '80s and early '90s, in large part because small- to medium-sized SMR systems bought its LTR and ESAS trunked radio systems and units. Unfortunately, by the mid-'90s, additional growth of trunking in the United States was jeopardized by federal regulation. "We were at the mercy of FCC rulings," Farina explained. "With the freeze on 800MHz licensing and rules that led to consolidation

and acquisition of our SMR system customers, it put the brakes on a thriving marketplace."

Uniden pursued two primary strategies during this period, one successfully (exporting), and one less successfully (220MHz products). "We have installed 7,500 trunked radio channels in mainland China," Hara said. "That's more than Motorola. Motorola has more market share. We have more channels," Sheriff added. "We've signed a contract worth about \$1.5 million with a Russian company, Scointek, for an ESAS network in Moscow."

Osler explained that, with a few excep-



Hara



Suzuka



Gordon



Sheriff



tions, all alliances that involve export sales through foreign companies are generated through the Dallas office. Pacific Rim countries are an exception, as is Brazil, where the private radio division has a resident representative. "We form alliances with dealers who have access to spectrum in their countries," Osler said. "In South America, some dealers have established relationships with large SMR carriers." He said that Beam Radio, a Miami-based distributor, handles many of the small Latin American dealers.

To put Uniden's export business in perspective, Hara said that the company has about 3,000 to 4,000 ESAS and earlier LTR channels in the United States, and about 10,000 ESAS channels worldwide, including the United States.

Uniden's other strategy for the mid-'90s, selling narrowband ESAS systems to 220MHz SMR operators, fizzled. Many speculators with no intention of building systems obtained licenses, forestalling construction until they might find buyers and making product sales forecasts highly uncertain. Some serious operators emerged, but without prospects for purchases in the quantities, Uniden needed to justify making 220MHz equipment. For example, an executive with one 220MHz network operator, Torrance, CA-based Roamer One, recalled that Uniden wanted an order for 38,000 mobiles to guarantee product support. "If we weren't willing, they weren't willing," said David Niebert, at the time Roamer One's president. Uniden subsequently discontinued its 220MHz product line, although it retains the "transparent tone-in-band" (TTIB) technology developed for narrowband ESAS trunking.

The TTIB technology, which uses narrowband modulation to place five channels in the spectrum occupied by a single 25kHz FM channel, might be pressed into service if Uniden's private radio division decides to field products to compete with capacity-multiplying trunking technologies. Current examples include Motorola's time-division multiple-access (TDMA) product, integrated digital enhanced network (IDEN), used by Nextel Communications and others; and Intek's advanced digital network trunking (ADNT) with linear modulation, used by Roamer. ComSpace's dynamic channel multiple-access (DCMA) system has reached the prototype stage.

"Uniden Research in San Diego has GSM ready to go," Hara said. "We completed TTIB in 1994. Thus, our division has a choice of research." Maybe this year, he said, Uniden will reach a conclusion and emphasize a particular direction for the next-generation trunking equipment with expanded capacity.

## IFR Systems acquires Marconi Instruments Ltd.

IFR Systems, Wichita, KS, has acquired Marconi Instruments, Ltd., Stevenage, England, along with all of its worldwide subsidiaries from the General Electric Company plc, London, for \$107 million in cash. Marconi Instruments, Inc., Fort Worth, TX, the U.S. subsidiary of Marconi Instruments, employs about 35 people and has annual sales in the

United States of \$24 million.

IFR Systems will merge Marconi Instruments' business with IFR's existing RF Division to form a larger test instruments division. Marconi Instruments, with trailing 12-month revenue in excess of \$110 million, designs and manufactures test and measurement equipment.



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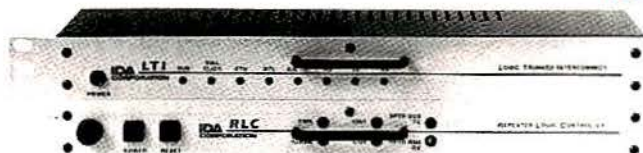
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## News notes

Montvale, NJ-based **Geotek Communications'** chairman, **Yaron Eitan**, said that "for companies with fleets, the last frontier of productivity and performance is the field." In response, the company is launching "Workpower for the Road," which merges several product lines into a single system to give mobile workers "real-time intelligence, empowering them with productivity tools and relieving stress and fatigue."

Lots of news from **Intek Diversified**, Princeton, NJ: The company changed its name to **Intek Global**. Its **Roamer One** subsidiary will consolidate 2,900 subscriber accounts and 220MHz systems from **Wireless Plus**, Hayward, CA, which it acquired. Intek chairman **Robert J. Shiver** said the company's linear modulation technology "already surpasses" the Europe-wide Narrowband Specification released for comment by the European Telecommunications Standard Institute's Technical Committee. One of Intek subsidiary **Midland USA's**

dealers, **Clark Data Systems**, Blackfoot, ID, is set to install a high-speed data and voice network on public safety 220MHz spectrum to serve the Bingham County, ID, Public Safety Department. Dealership co-owner **Roger Clark** said that the public safety sector "now has a wider selection of alternative technologies to meet a growing need for



Bayly

high-speed mobile data systems." Midland is prepared to assist entrepreneurs with the pending FCC auction of 220MHz licenses; access the company's auction hotline by calling 800-669-5549. "This is probably the first opportunity small business has had in these auctions

to date," said **Mike Bayly**, Midland's marketing director... "We chose to install a mobile data system primarily to fulfill part of the municipality's long-range plan to help improve officer safety, pro-



Clark

ductivity and efficiency," said **Lt. Jack McCrory** of the Penn Hills Police Department, commenting on the Pennsylvania city agency's rollout of a wireless data communications system that includes Stamford, CT-based **Software Corporation's** Premier MDT software and the use of **AT&T Wireless'** cellular digital packet data network. ... "No cohesive emergency response system currently exists in Allegheny County, PA, and the equipment is over 10 years old," said the county's deputy chief of emergency services, **Brad Magill**, in explaining why the county has selected **CML Technologies**, Atlanta, and **Sprint** to supply \$2.8 million worth of equipment for a county-wide enhanced 9-1-1 network.



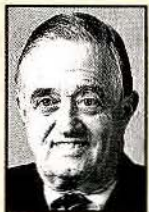
Magill

**Transcript International**, Lincoln, NE, has begun construction to add 33,000 square feet to its existing 40,000-square-foot headquarters building. The company sold \$1.5 million worth of wide-area LTR trunked radio equipment to Denver, CO-based **Centennial Communications** for use with radio systems it operates in South America. "Latin America's wireless com-



Young

munications needs are continuing to grow," said Transcript vice president **Joel Young**. Young also said that SEA, Mountlake Terrace, WA, has licensed Transcript's LTR-Net protocol and intends to use the protocol with its 220MHz portable and mobile radios. "The protocol offers a broad set of valuable features," said SEA president **David Thompson**.



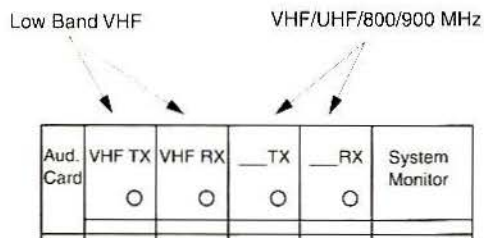
Thompson

Thompson and his customers, meanwhile, expressed enthusiasm for the FCC's planned 220MHz auction. "We have been waiting for some time to get this radio service going again," he said. The president of SEA's largest SMR (with more than 4,000 SEA units), **Gene Clothier** of Incom Communications, Irvine, CA, said that ICC "is relieved that the auction is finally happening." **Phil Adler**, chief executive of SEA dealer **PCS**



Adler

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Communications, said: "The 220MHz auctions represent an excellent business opportunity for two-way radio dealers."

**SiteSafe**, Arlington, VA (703-558-0511), assists communications providers in complying with FCC regulations regarding human exposure to radio-frequency electromagnetic fields. The new firm is a collaboration of **Biby Engineering Services**; **Lukas, Nace, Gutierrez & Sachs**; and **Thomas E. Lusk**. ... Bullhead City, AZ-based **Mr. Radio of Arizona** uses the Mega Switch made by **Hark Systems**,



DeWitt

Summerville, SC, to allow radio customers to dial locally on their SMR and paging systems to place long-distance calls within Arizona, California and Nevada. "We use the switch for least-cost routing on our SMR system, which allows us to perform least-cost routing for our own microwave system within the tri-state area," said **Eric B. DeWitt**, general manager of Mr. Radio.

Spotsylvania County, VA, has contracted **Ericsson Private Radio Systems**, Lynchburg, VA, for an 800MHz trunked ra-

dio system worth \$4.2 million. "The county is currently using a low-band conventional system and needs to upgrade," said **Doug Walker**, deputy county administrator. Hampton, VA, meanwhile, named Ericsson and bonding agent Federal Insurance in a \$7.5 million lawsuit involving an 800MHz trunked system installed in 1993 that the city claims does not work acceptably. Four Kansas City, MO, firefighters have sued Ericsson, consultant SFA and homeowner Lonnie Bond because they allege their radios did not work when they were inside Bond's house to fight a fire, according to *Dispatch Monthly*. The firefighters jumped out of a window when their radio calls for help were unheard by other firefighters outside the home. For \$1 million, Virginia's new prison in Sussex county bought an Ericsson three-channel 800MHz system that has been installed, tested and accepted. Speaking about the acceptance testing, Ericsson systems engineer **Matt Twiggs** said: "I had a prison official lock me in a metal, walk-in freezer in the middle of a concrete building. I made and received calls on an LPE 200 radio,



Twiggs

and was told the audio was crystal clear on all radios." Another Ericsson contract includes a \$10.4 million digital access system for Bell County, TX. "Several cities within the county wanted to upgrade their communications," said county communications director **Dan Engler**...

Among several reasons for choosing **Motorola's** HDT handheld data computer, "The drivers involved in the selection process preferred the terminal's large graphical display and full alphanumeric keyboard," said **Tom Zywicki**, director of system development for **Airborne Express**. A pilot mobile data system is set for installation in the fall for use by 150 Airborne drivers in St. Louis.

### On Target Mapping relocates

On Target Mapping has moved to a new facility in Monroeville, PA (a suburb of Pittsburgh) to accommodate growth and to serve customers.

On Target's toll-free number, Web and email addresses remain unchanged. The new address is: On Target Mapping, 300 Oxford Drive, Suite 350, Monroeville, PA 15146, 412-372-2399, fax 412-372-2307.



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## Dataradio courts resellers to increase distribution of products

Dataradio has started a new program that will increase the distribution of the company's products throughout the United States. Dubbed the Certified Select System Integrator (CSSI) program, Dataradio's new reseller structure will enable traditional land mobile equipment resellers to market and implement complete mobile computing systems.

Through CSSI, Dataradio will appoint

resellers who will operate in specific territories in the United States. Each prospective reseller will undergo training under the supervision of Dataradio sales and engineering personnel. Training will include classroom technical and sales instruction, as well as hands-on hardware field integration.

CSSI resellers will enter into a partnership with Dataradio. The resellers will be

given access to Dataradio partners in software and other products. Dataradio will also provide timely notification about new innovations in mobile data technology.

The best candidates for admission into the CSSI program will be radio communications sales and service companies that are interested in investing in the rapidly growing wireless computing network industry.

## American Mobile Satellite acquires Motorola's ARDIS

American Mobile Satellite, Reston, VA, will acquire Motorola's ARDIS data messaging business, which owns and operates a two-way wireless data communications network. When the acquisition is complete, American Mobile will become one of the country's largest providers of mobile data services to the transportation and field services industries, as well as others that rely heavily on mobile communications. The American Mobile network will offer combined satellite/terrestrial data capability for routing of data messaging. The transaction is contingent on government approvals and is expected to be completed during the first quarter of 1998.

American Mobile and Motorola have partnered in the past, with American Mobile's multimode messaging service employing the ARDIS network as one of its transmission pathways.

"Our customers have long told us the most important attributes of a wireless service provider are coverage and breadth of product offerings," said Walt Purnell, president of ARDIS. "The integration of ARDIS with American Mobile, while providing both voice and data solutions, also enables the joint entity to become the 100% coverage company."

ARDIS has also announced that Sears, Roebuck and Co. has signed a three-year contract extension for ARDIS network services. Extending to the year 2001, ARDIS will continue providing airtime for the 7,000 Sears Repair Services technicians operating on the ARDIS network.

In 1997, Sears Repair Services added satellite coverage from Norcom Networks to its wireless field service applications. Norcom resells satellite coverage from American Mobile. Through land and satellite, Sears has increased its coverage across the United States.



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## ITA, USMSS form alliance for coordination, conference enhancement, FCC representation

The Industrial Telecommunications Association and USMSS have formed an alliance of their organizations and memberships. The alliance will provide the USMSS membership with the opportunity to coordinate their communications regulatory efforts in cooperation with ITA. ITA and USMSS will also convene a joint annual conference every fall that will provide a forum for the exchange and presentation of

wireless communications regulatory issues, business enhancement processes, radio technology advancements and business opportunities in telecommunications.

"Through this affiliation, ITA has significantly enhanced its radio dealer associate membership roster," said Mark E. Crosby, ITA president. "We look forward to enhancing USMSS' representational effectiveness to provide these members with

educational materials, such as publications, papers, technical data and other information services."

ITA will represent the USMSS membership before the FCC and the U.S. Congress. The USMSS board of directors will vote on advocacy positions. USMSS will be a distinct market council of ITA, and its members will become associate members of ITA.



## Federal government shares frequencies with Wisconsin

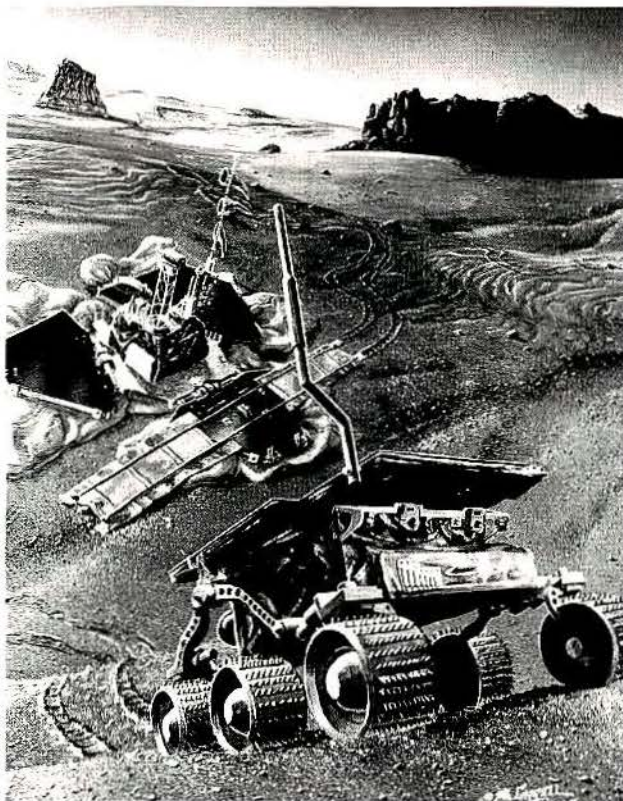
The National Telecommunications and Information Administration (NTIA), working with the Department of Defense, signed an agreement in March authorizing the state of Wisconsin to use federal radio frequencies to test a shared land mobile trunking communications system. The system will facilitate communications during emergencies as well as during day-to-day communications.

NTIA is a policy unit of the U.S. Department of Commerce. "The ability to communicate between levels of government has been a tremendous challenge in the past, only overcome on an *ad hoc* basis in the midst of an emergency," said Larry Irving, assistant secretary of Commerce for Communications and Information.

The pilot trunked radio system will allow the state of Wisconsin to work with federal, state and local officials to provide law enforcement protection and emergency management services. State and local officials will use the system to provide local and routine services involving law enforcement, fire services, emergency medical services, hazardous materials control, corrections administration, forestry management and highway safety services. A number of land mobile systems operated by federal agencies or by state and local governments around the country provide communications during emergencies. The Wisconsin pilot project will, however, be a system that provides shared services on a day-to-day basis.

The principal Federal sponsor in the Wisconsin pilot system, the Department of Defense, is working with the Wisconsin Department of Transportation to provide resources to develop the system.

The project will operate on frequencies in the 138MHz-150.8MHz range, currently assigned to the U.S. Army. The pilot system will use narrowband technology and will be capable of providing radio communications services in a digital mode. The agreement expires July 1, 2001.



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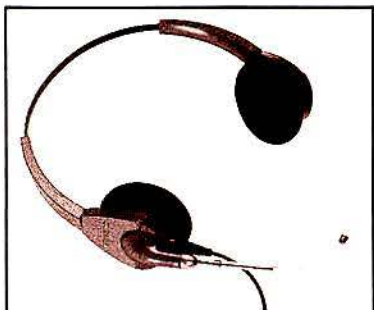
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*Headsets in the mobile communications industry serve several purposes. They are an integral part of surveillance, call centers, industrial work or day-to-day public safety communications. Featured below are a few specific products offered by headset manufacturers and distributors.*



### Communications headset

Encore from **Plantronics** is a light-weight communications headset with the SES (sound enhancement system) tone-control switch. Encore also supports Sound Guard Plus and Call Clarity technologies designed to deliver comfortable and clear volume levels with voice and transmission clarity. With multiple adjustments possible, the headset will fit just about anyone comfortably. The headband and turret are click-stop positionable to maintain the right fit. Binaural models are designed without a cable yoke. The headset is rugged; even the new lighter weight cables are strong. A durable turret and rugged cable strain relief provide a headset that can take perpetual use.

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### Noise-attenuating headset

**David Clark's** model H6040 headset is for use with portable and mobile radios. When combined with an adapter cord (specific to the radio) and the radio, the headset provides clear, crisp, voice transmission in high-noise environments. The headset's noise-canceling electret microphone is mounted to a universal flex boom assembly that rotates to the left or right side for microphone placement. An adjustable over-the-head support assembly allows the headset to be worn with all safety headwear, and foam-filled ear seals provide long-term wearing comfort. All components and cord assemblies provide protection from RFI and EMI. No radio modification is required.

Circle (303) on Fast Fact Card



### Intercom/radio mixer

The System 900 from **Setcom** is designed specifically as an intercom and radio mixer for fire service use. The headset provides 24dB of noise reduction meeting NFPA 1500. A noise-canceling microphone and a full-duplex intercom eliminate the need for a vox. Headset volume control and the radio push-to-talk button are mounted in the headset. The system is suitable for limited space installations.

Circle (304) on Fast Fact Card



### Wireless earphone

**Television Equipment Associates'** Collarset-II is a wireless earphone/concealed microphone with a press-to-talk switch that makes it possible for the user to transmit and receive radio signals with total secrecy. It is impossible to detect even at distances of two feet. The Collarset series attaches to any portable radio. The microphone is located under the user's clothing, near the collarbone, and the PTT switch can be in the hand, pocket or belt. The wireless induction earphone is totally hidden inside the user's ear and receives the radio signals magnetically from the inductor on the shoulder.

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### Radio headset

**Earmark's** self-contained radio headset, the series 4C, builds on the comfort and features of the original series 4 headset and the improvements of the series 4B. The series 4C is the lightest, most advanced Earmark headset radio. Its current configuration includes new, audio-enhanced speakers, improved electronics and low-profile antennas. For sound and volume control, the speakers are closer to and directly in line with the ear canal. The new speakers generate improved sound quality with flatter frequency response in the base and midrange.

Circle (302) on Fast Fact Card





### Lightweight headsets

Ultra headsets from **Otto Communications** provide high clarity, discrete two-way radio communications while allowing for the additional flexibility and comfort that comes from eliminating headbands. The lightweight headsets are compatible with a variety of radio makes and models. Component parts for custom applications are also available. The headsets feature flexible, electret boom mics with replaceable windscreens, "earbud" designs that eliminate the need for headband support and fully rotating boom mics and earbuds for left- or right-side positioning. The ear clip keeps the earbud securely in place. Headsets also come with replaceable earbud cushions and in-line PTT switches.

Circle (306) on Fast Fact Card



### Telephone headsets

**GN Netcom/Unex's** Advantage Plus series telephone headset systems are designed to withstand the heavy use of call center environments. The headsets provide durability and comfort, and superior sound quality with no increase in price over the existing Advantage series. Available in both monoaural and binaural models, the headsets are equipped with a noise-canceling microphone, the Stay-put adjustable headband and the Duraflex flexible boom.

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### Intrinsically safe headset

**RadioMate's** headset RMT 312 has received its second official compliance as intrinsically safe for use in classified hazardous locations. This lightweight headset can be paired with the RadioMate mini-in-line PTT switch or new belt-mount PTT certified for use on Motorola HT 1000, MTS 2000, MTX 9000 and Visar radios. Markets for this headset include oil and gas refineries, grain facilities, railroads and anywhere that ANSI/UL 913-88 requirements must be met.

Circle (309) on Fast Fact Card



### On-ear headset

The ParMarLow PWH6100 on-ear headset from **TwitCo** is lightweight and low profile. The headset does not interfere with headgear. It is built rugged for use in active environments such as SWAT teams and bike patrols. Features include direct radio connection and a hand-held PTT switch with clothing clip. The headset can be worn comfortably with a Nomax hood and most helmets. Optional ear molds provide a secure custom fit and are available for right or left ear in small, medium and large sizes.

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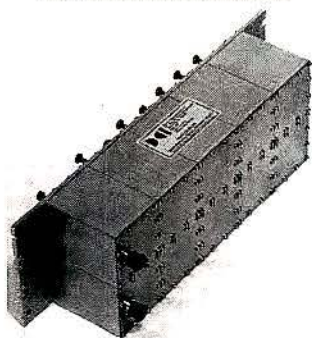


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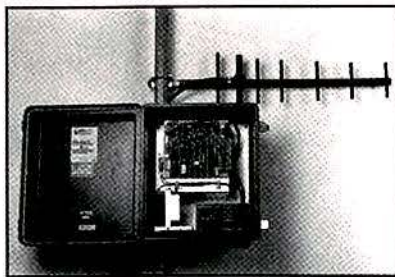
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## New products

### Readers' choice

Of all the new products and services in the September 1997 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

#### Telemetry unit works as wireless 'line-of-sight' conduit

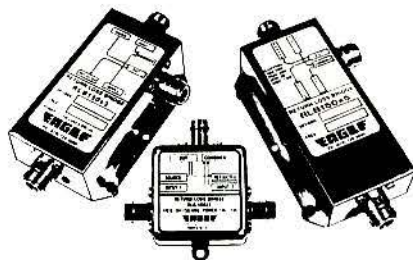


Zetron's Control Link+ model 1804 spread-spectrum telemetry units eliminate the cost of dedicated wiring and conduit or the recurring expense of leased circuits. Each unit functions like wireless conduit, instantly transferring

as many as 16 contact and eight analog inputs to corresponding outputs over line-of-sight distances of as far as 15 miles. Control Link+ can operate between two points or in multipoint configurations. The unit is for applications such as freshwater and wastewater, oil and gas production and pipelines, electrical power grids, plant security, industrial processes and traffic sign management. Control Link+ includes process interface inputs and outputs, a 902MHz-928MHz spread-spectrum radio, a yagi directional antenna, a NEMA 4X enclosure, a line power supply, a back-up battery and a charger. No radio license is required.

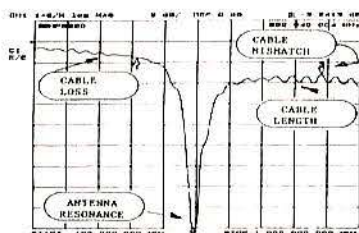
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#### Maintenance system tests batteries

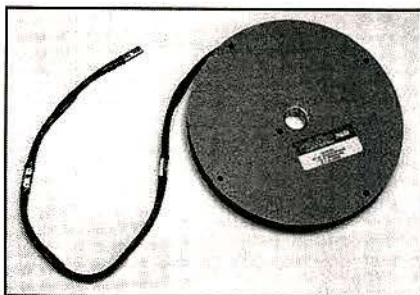


The Telepower IQfive from JBro's Telepower Batteries, is a NiCd and NiMH battery charge and test system with real-time clock, cycle test, accessory printer and optional data acquisition port. The cycle test feature forms and tests new batteries while reporting results on the IQfive printer. Batteries that need forming may exhibit a voltage depression (acts like a memory effect). This effect creates calls from the field asking, "Why is the new battery not performing like new?" These calls are reduced with the cycle test. The "analyze" feature measures the capacity and reports the results as milliampere hours on the optional printer and on the LCD read-out. This can be compared to the battery specification. The "condition" feature restores capacity in many cases by recycling the battery through three successive discharge and charge cycles. The printer offers detailed reports for all modes of operation and battery performance without a computer. A receipt can be generated for records or customers.

Circle (315) on Fast Fact Card



## Ground straps on a roll offer flexibility in bonding, grounding



Electric Motion's Microbond 2000 series, tinned copper rope-lay cable with pure

Circle (316) on Fast Fact Card

copper terminations, offers flexibility in bonding and grounding. Equivalent to a #6 AWG, Microbond has standard terminations every four inches, with 1/4" mounting holes. It comes on a 25' roll, so it can be cut to any length with scissors. Its design provides for easy installation. It terminates like any standard connection. Factory-installed terminations (one-piece for greater conductivity) provide maximum pull-out strength. Continuous loop eliminates the need to stock lengths of wire, crimp lugs and tools. It is available bare, or with extruded PVC insulation.

## Spread-spectrum systems provide wireless link for T1, E1 apps

World Communications Group's Wincom T-100 and E-100 spread-spectrum systems are full-duplex, high-speed digital microwave terminals. They provide a reliable wireless link for T1 (1.544Mbps) and E1 (2.048Mbps) applications. Using spread-spectrum technology, these systems facilitate voice, data and video transmission to a range of 45 miles. Virtually immune to atmospheric conditions, the systems offer

Circle (317) on Fast Fact Card

clear, robust communication with increased transmission security. Developed for use in the 2.4GHz ISM band, they do not require FCC site license. The Wincom system components include a rack-mountable modem unit containing a DSX-1 interface, a modulator and a power supply. An RF unit is located outdoors near the antenna, housed in a weatherproof enclosure. A coaxial cable connects the two units.

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## New products

### Feature turns any access control, security system into a paging machine

The Visiplex "free-text latch-on feature," now added to the Pocket Paging systems, allows a page to be delivered to a pager based on any test phrase (free text) that is sent to the VS2100, VS5100, VS6100 through their respective RS-232 serial ports. Access control, building automation, fire, nurse call, security and alarm systems with a serial or parallel printer port

can take advantage of this feature. Free Text shares the existing printer port. The user can preprogram the system to latch on a word or phrase in an alarm message sent to the printer and generate a radio page to a predefined pager or group of pagers. From 100 to 500 phrases of as many as 30 characters each (depending on the model) can be sent from the printer.

Circle (318) on Fast Fact Card

### Combination 300kA surge protector units fit wireless niche



Atlantic Scientific's 300kA surge protector, the Zonemaster SM series, combines metal-oxide varistor (MOV) and silicon avalanche diode (SAD) technology in a modular package. The protector uses a mix of individually replaceable MOV and SAD modules. SAD modules use surface-mount SAD components in a matrix on a three-layer, ultra-low impedance PCB. MOV modules contain three-terminal, large block MOVs with each module having dual redundant stages for high reliability. MOV and SAD modules are completely interchangeable when installed in the Zonemaster housing, allowing a large range of new products by mixing combinations of modules in a single unit.

Circle (319) on Fast Fact Card

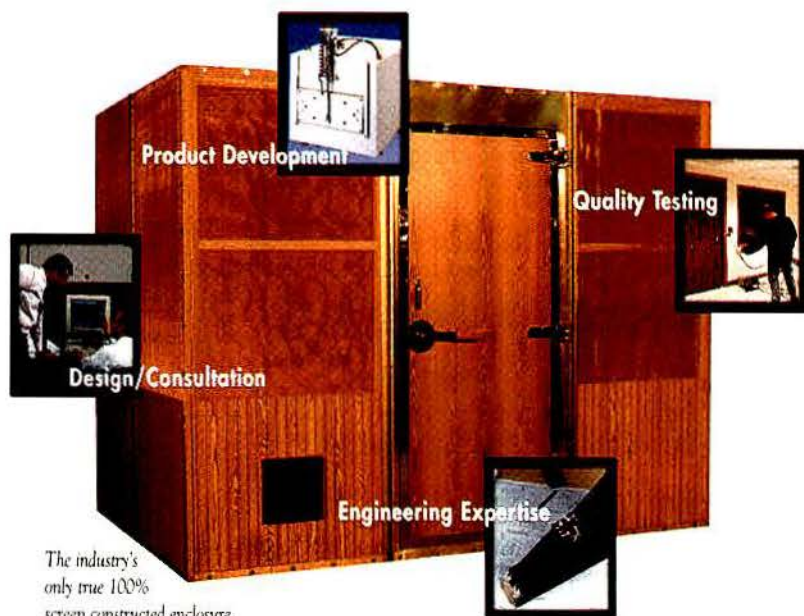
### Field scrambler unit helps SMR operators to provide privacy



Pacific Circuit's FSU is a VSB rolling code scrambler that functions with the full duplex terminal scrambler unit, which has provision for as many as 10,000 exclusive codes. A PC program is used to program the FSU with an exclusive ID code. The terminal scrambler unit activates or deactivates the FSU's encryption on a request initiated from the FSU, and the FSU will function on system audio delays as long as two seconds. The unit is suitable for SMR operators that want to provide telephone privacy on their telephone networks coupled with simplicity of installation and setup. The unit will work well on radio systems with audio delays introduced by satellite uplinks. Other types of radio equipment can be interfaced through the option connector. The FSU comes in an all-metal enclosure and has its own volume control and a 2.5W RMS speaker.

Circle (320) on Fast Fact Card

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Circle (60) on Fast Fact Card



## Enhanced spectrum analyzers improve measurement time



Anritsu's line of portable spectrum analyzers, the MS2650B and MS2660B series, offer enhanced measurement capability, improved measurement time and greater display resolution in compact housings. The MS2650B series has a 9kHz to 3GHz frequency range, and the MS2660B series covers the 9kHz to 8.1GHz range. The display update rate and PTA (personal test automation) processing speed of both series are 30% faster than previous models. The improved speed is due to an increase in the CPU clock to 16MHz and display update rate clock increase to 6.4MHz. Software enhancements have also been made that result in improvements to the adjacent channel power measurement function and the addition of channel power measurement capability. An improved LCD display makes reading and analyzing data easier. The analyzers have standard functions that were previously only available as options. They feature a built-in frequency counter, FM demodulation waveform display, GPIB or parallel interface, and memory card interface.

Circle (321) on Fast Fact Card

## Repeater features low-profile design



The KSG-4500 continuous-duty UHF repeater from Kenwood Systems is a rack-mounted repeater that operates as a conventional station or as part of an integrated trunking system. The repeater features a low-profile design that makes efficient use of rack space. It is completely self-contained with its own integrated RF amplifier and power supply. This compact, 100W, continuous-duty unit is also equipped with built-in forced air cooling. All components are easily accessible to technicians, making field servicing fast and easy.

Circle (322) on Fast Fact Card

## Package offers site monitoring of various alarm conditions

Hark Tower Systems' extended site monitoring option is for the TSM 2000 tower site monitoring system. The monitoring package offers site monitoring of various alarm conditions, lights and open doors with options for card access and light control. This option allows operators to read as many as 256 analog sensing points throughout a tower site. Voltage, temperature, fluid levels, cur-

rents and humidity are among the conditions that can be monitored with extended site monitoring. For example, with the option, engine speed, oil pressure and output voltage can be monitored for on-site generators. The generator can be remotely cycled via the standard TSM 2000 dial-up feature. The option can also be set up to send an alert when the generator has automatically started.

Circle (323) on Fast Fact Card

## INTERCONNECT SOLUTIONS

The company that developed the first microprocessor-based radiotelephone interconnect now presents the most advanced simplex and half-duplex interconnect of its kind: the ITI6000. Wireless-to-landline communications have never been more powerful. Its DSP-based design ensures reliability and quality. This interconnect is also fully remote-programmable via PC and modem.



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Circle (61) on Fast Fact Card

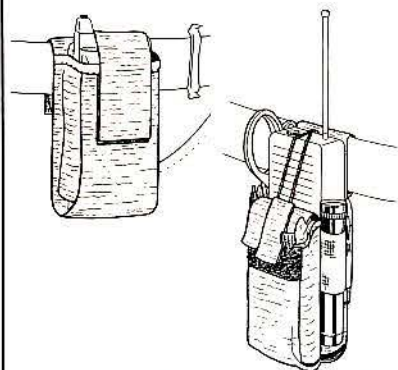


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Circle (63) on Fast Fact Card

## New products

### Compact base station covers wrap around selected radios



ICT's base station series wraparound covers fit selected models of mobile radios, such as E.F. Johnson, Ericsson, GE, Kenwood, Maxon, Midland, Motorola, Standard, Tait, Uniden and Vertex. The covers are easy to install, have a clean, sleek compact design and complement ICT's 10A through 30A switching power supplies. Purchase the complete base station (power supply assembled with cover) or the power supply and the cover separately.

Circle (324) on Fast Fact Card

### Crystal filters are custom- manufactured, compact

International Crystal Manufacturing makes both custom and standard filters, and offers monolithic crystal filters (MCF) with nominal frequency series of 10.7MHz and 21.4MHz. Also available is a high-frequency series ranging from 45MHz to 90MHz. Filters range from two- to eight-pole and are packaged in a compact design. Front-end crystal filters are available, with two to four poles, with center frequencies based on model numbers ranging from 30MHz to 174MHz. ICM standard crystal filters are tested and specified at -20°C to 70°C with custom temperature specifications available if values are specified when ordering.

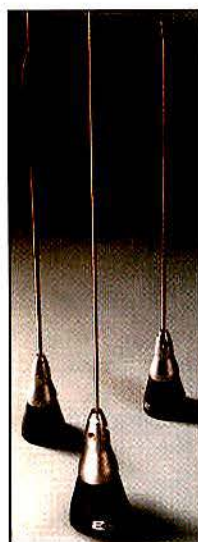
Circle (325) on Fast Fact Card

### Antennas available without spring

#### The Antenna Specialists Division of Allen Telecom

has added a springless option to its Mosaic LMR vehicular antennas. The springless option is for applications in less rugged operating environments where the durable elastomer Dura-flex spring found in the existing Mosaic line is not necessary. The new springless Mosaic is available in both conversion and component forms for either VHF (3dB gain) or UHF (3dB and 5dB gain) frequencies. Users may choose rooftop, magnet, snap-in and thick-roof mounting options to install with their conversion antenna.

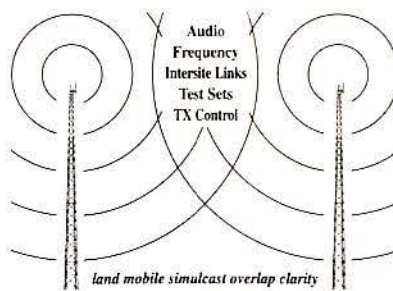
Circle (326) on Fast Fact Card



### 9-1-1 console system combines response, radio dispatch

The Centralink/Palladium 9-1-1 system from Motorola's Land Mobile Products Sector allows communities to combine 9-1-1 response and radio dispatch using Motorola Centracom Gold Elite consoles on a Microsoft Windows NT operating system. The Centralink/Palladium 9-1-1 system provides all the information dispatchers need on a single screen. It offers integration with Telephone Device for the Deaf equipment as a standard feature and integrates with other NT-based equipment, including systems used for mapping, computer-aided dispatch, records management and audio recording.

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### Repeaters offer cross-band capability

Daniels Electronics' line of MT-3 cross-band repeaters can now be configured to work in the VHF



low band. This makes it possible for low-band users to communicate with users of other bands such as AM, FM, UHF, VHF or 800/900MHz. Different radio modules plug into Daniels' standard 19" sub-rack. The modular nature of the equipment also makes maintenance and upgrades simple and quick. At 5 1/4" high, the repeater is compact. The repeaters are for VHF low-band users such as highway patrols, departments of transport and utility and energy companies. U.S. government agencies should also note that Daniels' equipment is available on GSA and CMAS contracts.

Circle (328) on Fast Fact Card

### Coaxial cable works for long cable runs

Trilogy Communications' 5/8" Aircell Transline cable is for sites where long cable runs are not required, but low attenuation is important. This new coaxial cable features a non-pressurized air dielectric that provides attenuation and protection against water migration. The mechanical properties are durable, ensuring easy installation and long service life. It is also available as an Aircell Radiating product.

Circle (329) on Fast Fact Card

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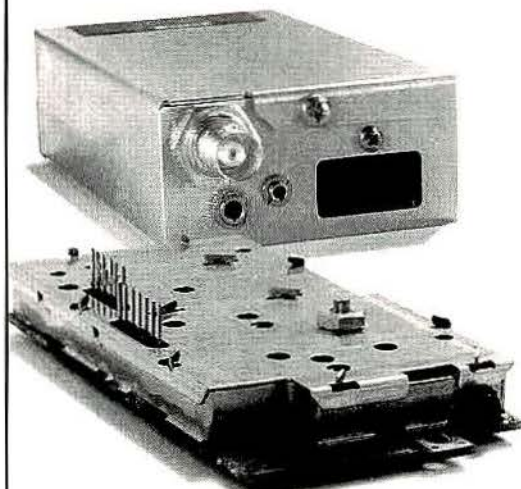
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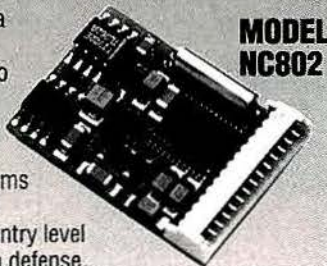
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The Model NC802 is a miniature inversion scrambler designed to provide intermediate level security for two-way radio voice communication systems and is a perfect, cost effective solution to entry level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.



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## New products

### Power center offers fingertip control

Gamber-Johnson's switch control power center, part of the ValuePlus series, has a self-contained fuse block with



170A power capacity. It is fully assembled with seven heavy-duty SPST switches, including one 40A and six 20A. It has four open circuits for auxiliary equipment, three 20A feeds and one 10A feed. The center is wired with six-gauge wire output and 10-gauge ground. The center features a power-distribution system contained in one vinyl-coated finished case, backlit legends that are visible day or night and switches that are easily controlled, even with the gloves on. It fits consoles and rack systems and can be mounted overhead or in the dashboard. The center is offered in two versions: an open model, with extended faceplate for mounting, or an encased model.

Circle (330) on Fast Fact Card

### Test unit works for service shops

GoComm Wireless' MiniShield, Model 91 (with -75dB isolation), is an RF isolation test unit for use in repairing, aligning and recrystallizing pagers, cell phones, two-way radios and other wireless equipment. The item was developed for service shops, which many times do not have the space for large and costly screen rooms. Designed for use on service benches, the unit measures 13" x 7" x 7".

Circle (331) on Fast Fact Card

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## UPS maintenance bypass makes uptime possible



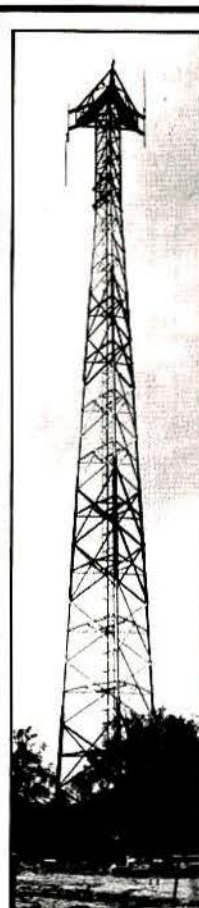
Liebert's Micro-pod is a maintenance bypass option for its uninterruptible power supply (UPS) customers. The cord-and-plug design provides a method of eliminating critical load shutdown during routine maintenance replacement of UPS units. Micropod works in conjunction with Liebert's Powersure, Powersure Interactive, UPStation D, UPStation GX and UPStation GXT.

Circle (332) on Fast Fact Card

## Monopole base works for temporary tower sites

PiRod's portable monopole base is for temporary and semipermanent installations, or permanent sites where conventional foundations are impractical. The base is designed to maintain full safety factors and EIA code compliance. The integrated base, monopole lifting hooks and modular construction allow for one-day setup, making it suitable for transient coverage needs or emergency replacement of out-of-service equipment. The portable monopole base is for placement on soil with as little as 1,500psi bearing capacity, and can accommodate a 30"-diameter monopole with a maximum overturning moment of 500 feet/kips.

Circle (333) on Fast Fact Card



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Circle (84) on Fast Fact Card

## New products

### Portable radio offers four channels



The Jobcom JBX 5W hand-held radio from **Ritron** now has four operating channels, including the color dot (VHF/UHF) and color star (UHF) frequencies (custom frequencies are also available). The JBX's expanded capability provides separate frequencies for work groups, yet retain the ability to talk among groups when necessary. If a frequency becomes noisy or congested, the JBX's quiet call privacy feature eliminates congestion on any of the operating channels. Channel scan allows the JBX to continuously monitor frequencies. The JBX can transmit to the last channel received. The JBX-155

VHF has weather scan. The 5W JBX delivers a talk range of as far as five miles. It can penetrate buildings up to 25 floors, or an area as large as 300,000 square feet.

Circle (334) on Fast Fact Card

### Dc remote control unit offers on-board programming, intercom mic

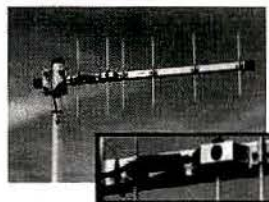


**Solid State Communications'** 815R series of dc remote control units incorporate the features of the 811Y series. The 815R models also feature on-board programming, including the current formats - 1.5mA, +6mA and +12mA. The unit also includes a built-in intercom mic, a compression/amplifier on transmit and receive, four-wire capability for trunked or duplex operation and convenient modular telephone-type jacks (and screw terminals) housed in a sleek grey console. The console can be wall-mounted or used as a telephone-style desktop unit.

Circle (335) on Fast Fact Card

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Circle (74) on Fast Fact Card



### Antenna offers long-term reliability

Astron Antenna's cellular base station antenna, model PCD8-10 uses a dipole array configuration to obtain a gain of 11dBi. The antenna features long-term reliability and half-wavelength spacing capability. This model covers the 806MHz-894MHz range. The VSWR is 1.5:1, with a front-to-back ratio of 20dB and 50Ω impedance that makes this dipole array compact and efficient. The rugged construction allows it to withstand 150mph winds, while the UV-protected ABS plastic radome protects it from the elements.

Circle (336) on Fast Fact Card

### Amplifier offers high gain per stage

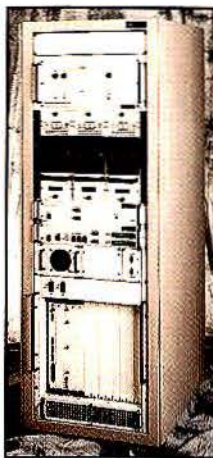
AML Communications' RMPA-1, 30W GMSK modulation paging amplifier is for operation in the 935MHz-940MHz paging spectrum. This product is represented in a 19", two RU high, rack-mount chassis with internal cooling fans. Implemented in LDMOS FET technology, the RMPA-1 provides ruggedness, reliability, higher gain per stage and improved efficiency. RF input to output bypass is activated on incidence of over-temperature, loss of ac power or amplifier device failure.

Circle (337) on Fast Fact Card

### Base station supports all combinations of full mobility

A new version of the Base2 Macrocell base station from Watkins-Johnson Telecommunications Group is a dual-mode AMPS/IS-136A software-definable base station for both mobile and fixed wireless applications. The base station is available either as an OEM product or as part of the Base2 Wireless Communications System in a full system deployment. It supports all combinations of full mobility, limited mobility, and fixed-access dual-mode IS-136 and AMPS wireless applications. Base2 Macrocell's radio system provides network and service expansion as well as feature enhancements, via remote software upgrades.

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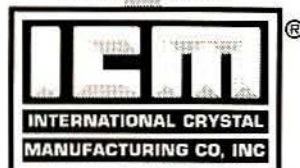


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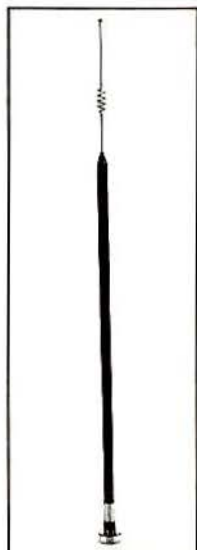
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## Literature

### Test & measurement catalog contains 1,400 products

Hewlett-Packard's 1998 edition of the *Test & Measurement Catalog* includes descriptions of more than 1,400 test and measurement products, systems and services. The 640-page catalog provides a convenient source for researching, planning, budgeting and purchasing a broad range of test products and services. Along with descriptions and technical specifications of standard products and systems, the catalog includes product-comparison charts, tutorial material, indexed lists of applications notes and descriptions of other available literature, such as newsletters and specialty catalogs.

Circle (351) on Fast Fact Card

### Catalog covers AM/FM, cellular, PCS antennas

Hirschmann's 16-page catalog covers the company's full line of AM/FM, cellular and PCS mobile antennas and accessories. The full-color catalog includes data on Hirschmann's new cellular/SMR antenna, which helps preserve a car's aesthetics by being completely hidden in a non-metallic front or rear bumper. It also covers a new addition to Hirschmann's family of glass-mount wireless phone antennas, the PCS/cellular, which has a 3dB gain for AMPS and 2dB for PCS. The catalog also contains facts and specifications on the company's line of fixed and retractable AM/FM antennas including roof-mounted, automatic and electronically amplified models, plus OEM replacement models, mounting heads and adapters, cables, covering bolts and antenna-care products. It also covers its tri-band AM/FM cellular antennas, as well as the line of professional cellular antennas. The catalog concludes with two pages on the "ABC System," which offers those who wish to design their own mobile antenna system a choice of compatible antenna-base-and-cable components.

Circle (352) on Fast Fact Card

### Product resource guide offers tool kits, test equipment

Jensen Tools' new catalog has been developed specifically for the global communications industry. The 100-page, color *Products Resource Guide* encompasses a full range of products for telecommunications, data communications, audio visual alarm communications, wireless communications and cable television. It includes tool kits, telephone test equipment, cable and electronic test equipment, specialty tools and service aids.

Circle (353) on Fast Fact Card

### Catalog offers coaxial products

Catalog #1998 from Pasternack Enterprises (Coaxial Products Division) includes hundreds of new products with technical information. The 98-page catalog offers several coaxial products including adapters, attenuators, circulators, cable assemblies, connectors, switches, de blocks, directional couplers, tools and more. The catalog offers connector identifier charts, with a model number index.

Circle (354) on Fast Fact Card

### Catalog offers FM radio products

Earmark's 1998 *Better Tools for Productivity* catalog is an 18-page, color catalog that provides graphic, textual and specification information for a complete range of FM radio products. The non-technical approach to communications systems makes it easy to choose the right product for harsh industrial environments. The catalog first identifies Earmark's latest product models and elaborates on the individual features and benefits of the self-contained, radio headsets, Belt-Paks, Flex-Paks and repeating base stations. The catalog also provides an illustrated description of more specialized communication systems such as Conkit for communication into and out of permit-required confined spaces and tour and training systems for high-noise environments.

Circle (355) on Fast Fact Card







Sirvio



Daly



Larralde



Barnholt

**David Sirvio** leaves Ortel, Alhambra, CA, as director of world-wide business development and strategic accounts to join Advanced TechCom as senior vice president of sales.

Changes at Kenwood Communications, Long Beach, CA:

**Cheryl Daly** joins Kenwood as sales administration manager after 17 years of experience in electronics manufacturing and management. **Luis Larralde** joins Kenwood as international regional sales manager after holding a similar position at Hutton Communications, Dallas.

**Edward W. Barnholt**, executive vice president of the Test and Measurement Organization at Hewlett-Packard, Palo Alto, CA, becomes executive vice president of a newly created Measurement Organization, formed by merging the Test and Measurement Organization and the Measurement Systems Organization.

**Richard C. Cope**, who served as a consultant to Advanced Charger Technology, Atlanta, throughout its startup period, becomes chief operating officer for the company.

**Craig Huffaker** departs TIE Communications, Kansas City, MO, as chief financial officer, to join Transcript International, Lincoln, NE, as senior vice president, finance.

Changes at Metawave Communications, Redmond, WA:

**Richard Henderson** leaves Nortel's cellular group, Richardson, TX, as vice president of marketing operations, to join Metawave as vice president of sales and marketing. **Ray Butler**, director of system architecture advances to vice president of engineering. **Robert Shuman**, director of digital products, moves up to vice president of product management.

**Michael Owens** joins the Grayson Wireless division of Allen Telecom, Forest, VA, as European sales manager, after working at LCC International, McLean, VA, as account manager.

**D. Gregg Marston**, controller, moves up to vice president of finance for Princeton, NJ-based Intek Global. He replaces **Lee Montellaro**, who is leaving to pursue other business interests. **Louis J. Monari** leaves Digital Solutions, Somerset, NJ, as vice president to join Intek as vice president of administration.

**Geoffrey Scott Carroll** joins LCC International, McLean, VA, as president after leaving Brussels, Belgium-based Origin B.V., the information technology services subsidiary of Philips N.V., as chief executive officer.

**Richard D. Parlow** retires from the Commerce Department's National Telecommunications and Information Administration (NTIA), having served in the Office of Spectrum Management as associate administrator since 1983. He becomes director of international government at Iridium, Washington, DC.

**Raymond F. Wisniewski** joins the Industrial Telecommunications Association, Arlington, VA, as director, marketing and meeting administration, after leaving ESSI, as association marketing firm, as principal.



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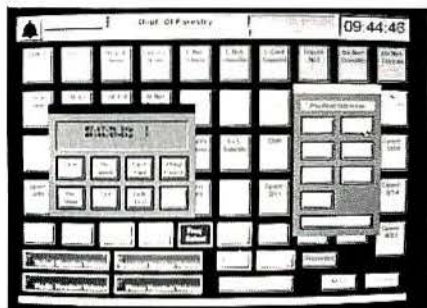
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## Letters from readers

### Digital-analog interference growing on a daily basis

Hat's off to you for your article on digital-analog interference in the March 1998 issue. This is a major problem found throughout the paging, SMR/ESMR, cellular and two-way business that seems to be growing on a daily basis. Although your article never comes out and specifically points a finger at the cause, it is well-known throughout the industry where the problems are coming from. With RF spectrum becoming more crowded, regardless of where you operate, we need to



begin policing our own networks in order to correct these types of interference issues. I can only speak for the paging industry, but too often we see equipment operating at maximum power and with deviation levels set at 5kHz simply because that is what the FCC allows. The pagers we are trying to reach perform at the same level whether we deviate at 4.5kHz or 5kHz, so the only difference seen is the adjacent channel interference, which is inflicted on our neighbors. Since the FCC also began allowing paging sites a maximum ERP of 3,500W, we have seen the introduction of 500W bases stations and a corresponding rise in the amount of interference complaints. Again, transmitting at 3,500W vs. 1,000W is negligible in the performance of the actual pager being carried by a customer. All we have done is degrade someone else's service to the public. The vast majority of my network expansion in the past three years has been to simply overcome the rise in the noise floor caused by adjacent channels operating at unnecessarily high power and deviation levels.

We are living in an extremely crowded RF world, and it is well beyond the time that we begin taking into account not only our own networks but those of our competitors and other businesses occupying bandwidth near our own. The FCC is not going to correct this problem, so it is entirely up to the industry to operate within acceptable technical standards, and those are not found in Parts 21, 22 or 90. Common sense and consideration for your RF neighbor is the only way our interference problems are going to be corrected. Thank you once again for a wonderful article.

—Glen Sparks  
Engineer  
Ameritech Cellular & Paging



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Technical information for paging, SMR and private wireless networks

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## Category Index

Accessories	81
Business Opportunity	79
Computer Software	92-93
Employment	79-80
Equipment For Sale	82-91
Equipment Wanted	91
Manufacturers' Reps	79
Paging	92
Professional Services	79
Professional Consulting Services	81
Rentals	92
Repair Services	94
Services	81
Tower Services	95
Tower Space	95

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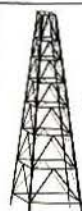
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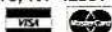
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200	Motorola Mitrex 30-39 60 W With accessories	\$125 ea
03	Motorola Micor Base 113 W High Band	\$600 ea
08	Motorola Micor Base 110 W 36-42	\$500 ea
20	GE TMX 8825	\$150 ea
20	Ericsson-GE MDS-TL800	\$160 ea
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14	Johnson UHF LRT 5963 with charger	\$100 ea
80	GE TMX 8615 G-mark	\$125 ea
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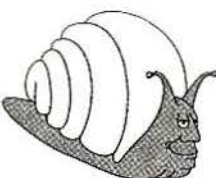
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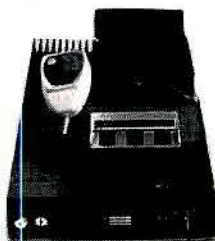
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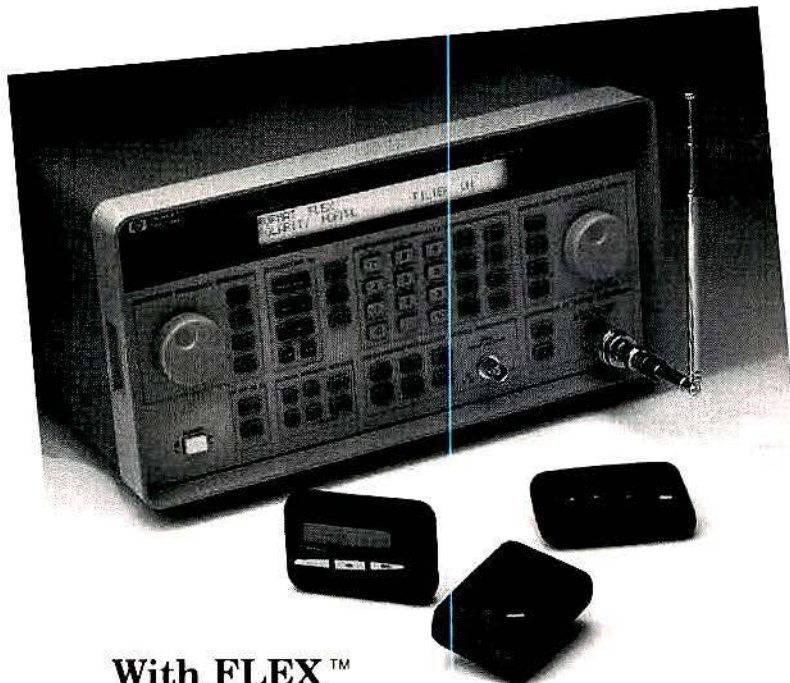
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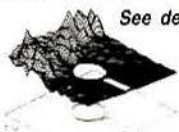


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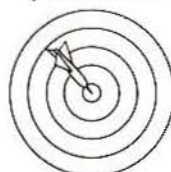
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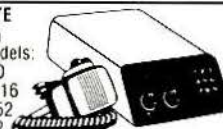
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# A d index/hot line

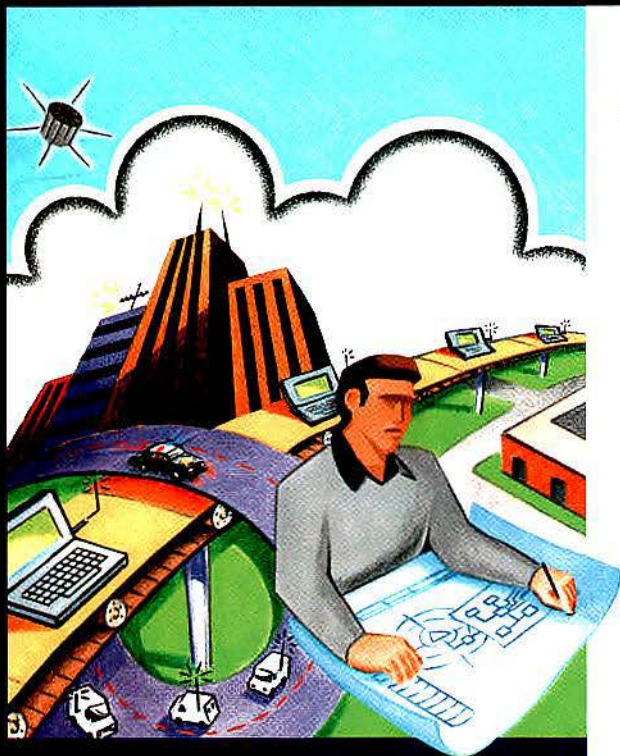
Company	Page Number	Fast Fact Number	Advertiser Hotline	Company	Page Number	Fast Fact Number	Advertiser Hotline
AF Comm Supply .....	73	72	800-255-6222	Kenwood Communications .....	35	28	800-950-5005
Air Comm .....	84	106	602-275-4505	Klein Electronics .....	85	108	760-631-2811
Alexander Batteries .....	27	21	800-247-1821	Larsen Electronics .....	58	51	800-426-1656
Andrew Corp. ....	12	9	708-349-3300	Leavitt Communications Inc. ....	50	42	847-676-8282
Anritsu Company .....	9	8	408-778-2000	Lindgren R.F. Enclosures Inc. ....	68	60	708-307-7200
Antenex .....	83	105	800-323-3757	Marketronics .....	28	22	800-845-1230
Astron Corp.-Irvine, CA .....	21	17	714-458-7277	Maxrad, Inc. ....	IBC	2	630-372-6800
Astron Corp.-Sterling, VA .....	74	73	703-450-5517	McManus Communications .....	89	115	870-763-6250
Avtec, Inc. ....	77	79	803-892-2181	Mechem Electronics .....	82	102	540-891-0569
Barnett Electronics Inc. ....	83	104	800-423-3858	Micropath Corp. ....	93		303-526-5454
Battery Pro .....	67	82	800-661-9401	Midland LMR .....	7		800-MIDLAND
BEE Electronics .....	32	26	800-336-3115	Modular Comm. Systems .....	78	80	818-764-1333
Berkeley Varitronics .....	53	46	732-548-3737	NARDA/L3 Communications .....	15	12	516-231-1700
Bird Electronic Corp. ....	36	29	216-248-1200	N.C.G. Co. ....	76	78	714-630-4541
Brown and Schwaninger .....	92	124	202-223-8837	New Hampshire Communications ...	89	117	603-668-3004
Canadian Marconi .....	72	50	613-592-6500	New York Communications .....	90	118	914-471-5520
CELWAVE .....	25	20	800-321-4700	Norcomm Corp .....	72	67	916-477-8400
ChargeGuard Corp. ....	74	84	800-458-3410	Optoelectronics Inc. ....	IFC	1	800-327-5912
CommScope Inc .....	40	31	704-323-4819	Optoelectronics Inc. ....	41	32	800-327-5912
Communications Specialists .....	BC	3	800-854-0547	PageCo .....	92	122	954-776-0031
Communications Data Svcs. Inc. ...	93	126	800-441-0034	PageCorp Industries .....	92	121	800-957-8700
Computer Resources Inc. ....	92	123	205-987-1523	Paging & Wireless Service Center ...	91	119	561-683-0022
Connect Systems Inc. ....	47	38	800-545-1349	Polaris Industries .....	85	107	404-872-0722
Control Signal Corp. ....	54	47	800-521-2203	Polyphaser Corp. ....	56	49	800-325-7170
Cooper General Corporation .....	89	114	305-223-6399	Premier Communications .....	71	65	909-869-5711
Corporation Ten International .....	62	55	410-821-0008	Primus Electronics Corp. ....	75	77	800-435-1636
CPI Communications Inc. ....	65	57	972-437-5320	Radio Express, Inc. ....	82	103	800-545-7748
Crystronics, Inc. ....	92	122	954-776-0031	Raine, Inc. ....	70	62	765-622-7687
Daniels Electronics .....	60	53	604-382-8268	RCC Consultants .....	81	100	732-404-2400
Dapa Communications, Inc. ....	5	6	716-373-7228	RCW Distributing .....	85	109	800-726-9015
David Clark .....	24	19	508-751-5800	Ritron, Inc. ....	55	48	800-USA-1USA
Dataradio Corp. ....	63	56	770-392-0002	Ritron, Inc. ....	71	66	800-USA-1USA
Decibel Products Inc. ....	17	13	214-631-0310	Selectone .....	29	23	510-781-5432
Digital Communications Inc. ....	66	83	306-781-4451	Sharp Communication .....	89	116	800-548-2484
Doppler Systems, Inc. ....	74	74	602-488-9755	Shure Brothers Inc .....	45	36	800-25S-HURE
Doug Hall Electronics .....	67	59	614-261-8871	Simulcast Solutions .....	70	64	716-223-4927
Duracomm Corp. ....	48	39,40	816-472-5544	Sinclair Technologies Inc. ....	52	44	800-263-3275
DX Radio Systems .....	42	33	213-257-0800	SoftWright .....	93	125	303-344-5486
EAGLE .....	66	58	520-204-2597	Solid-State Communications .....	1	4	800-227-1226
El Paso Communication Systems ....	87	112	915-533-5119	Survey Technologies Inc. ....	14	11	503-591-5986
EMR Corp. ....	57	68	602-581-2875	Sutter Buttes Two Way .....	88	113	530-674-7532
Eupen Cable USA .....	44	35	813-527-7955	Telepath .....	59	81	510-656-5600
Gabriel Electronics .....	61	54	207-883-5161	Television Equipment Associates..	73	71	310-457-7401
Galaxy Power, Inc. ....	75	76	610-676-0188	Telewave Inc. ....	20	16	415-968-4400
General Communications .....	94	128	800-356-3200	TESSCO .....	13	10	410-229-1000
The Genesis Group .....	93	127	903-561-6673	Thunder Eagle .....	70	63	703-242-0122
Hewlett Packard Co. ....	86	110	707-577-2265	Transcrypt International Ltd. ....	19	15	800-894-2609
Highpoint Tower Technology Inc. ...	95	129	813-854-1518	Trylon Mfg Co Ltd .....	73	70	519-669-5421
Richard Hirschmann .....	46	37	973-835-5002	Twitco Distributing .....	53	45	800-899-8948
Hustler Inc .....	37	30	800-949-9490	TX RX Systems Inc. ....	3	5	716-549-4700
Hutton Communications .....	91	120	800-442-3811	Uniden Corp. ....	31	25	817-858-3300
ICOM America .....	33	27	206-450-6041	Vega, A Mark IV Company .....	18	14	818-442-0782
IDA Corporation .....	59	52	701-280-1122	Vocom Products Co. LLC .....	72	69	800-USA-MADE
IFR Systems, Inc. ....	23	18	316-522-4981	WETEC Electronics .....	87	111	901-286-6275
IFR Systems, Inc. ....	81	101	316-522-4981	Zetron Inc. ....	30	24	425-820-6363
Instrument Associates .....	69	61	901-947-4000	Zetron Inc. ....	43	34	425-820-6363
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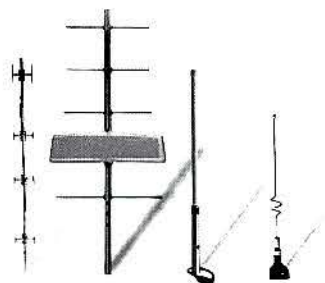
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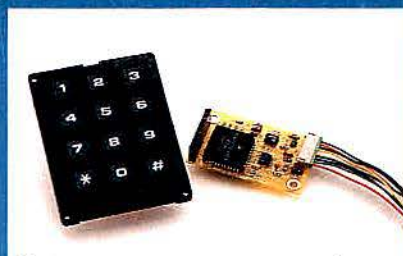
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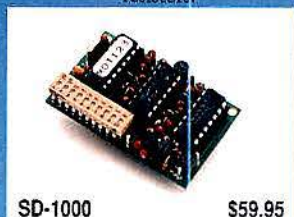
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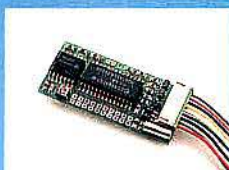
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